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Dr. W. R. THOMPSON, F.R.S.

Head Office—British Museum (Natural History), Cromwell Road, London, S.W.7.

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Box (H. E.). **Citrus Moth Investigations. Report on Investigations carried out from December, 1939 to August, 1941.**—iii+64 pp., 1 fldg. map, 1 graph, typescript. Asuansi, Colon. Developm. Fund, 1941.

This report comprises a detailed account of investigations in 1939–41 on the identity, status and bionomics of Noctuid moths that pierce *Citrus* fruits in the Gold Coast Colony and Southern Ashanti, together with recommendations on methods of control [*cf. R.A.E.*, A **29** 106].

In the first part (pp. 4–17), accounts are given of the general situation and of the course of attack on *Citrus* at Asuansi (Central Province) in 1940 and on *Citrus* and other fruits at Asuansi and elsewhere in 1941. A total of 112 species were found to puncture *Citrus*, and a list is given of the 86 that were identified. All the species are classified into five groups according to their economic importance in 1940 and 1941 ; only 23 were of any importance and only 12 were responsible for more than slight damage. These were *Achaea lienardi*, Boisd., *A. mormoides*, Wlk., *Anomis leona*, Schaus, *Heliophisma catocalina*, Holl., *Ercheia* (*Melipotis*) *subsignata*, Wlk., *Othreis divitiosa*, Wlk., and *O. fullonia*, Cl. (*fullonica*, L.), which were of major importance, and *Achaea catocaloides*, Gn., *Dermaleipa parallelipipeda*, Gn., *Nyctipao* (*Erebus*) *walkeri*, Btlr., *Miniodes discolor*, Gn., and *Serrodes trispila*, Mab., which were of average importance. In a discussion of the injury to fruit, a list is given of 15 cultivated plants of which the fruits are attacked in the Gold Coast ; the fruits of two wild plants were also pierced. Injury to shaddock, lemon and citron is reported apparently for the first time in West Africa [*cf. loc. cit.*]. Damage to lemon was most severe in the absence of other suitable *Citrus* fruit in the right stage for attack. Oranges and grapefruit are liable to injury throughout the Colony ; losses appear to be heaviest in the coastal and adjacent forest regions, and were comparatively low in the northern part of the Colony and in Ashanti. The yields and percentages of punctured *Citrus* fruits in two blocks at Asuansi in 1940 are summarised in a table. Tomatos were severely injured at Asuansi for the first time in late May 1941 ; the fruits were attacked while still green, and almost the whole crop was destroyed. The course of the infestation and the numbers of moths caught on *Citrus* in each of the two years are also summarised in tables.

The second part (pp. 18–35) deals with the bionomics of fruit-piercing moths, and includes a detailed account of the ecology of various regions in which breeding occurs in the Gold Coast, and a list of 132 food-plants, representing 31 families, that are attacked by larvae of 69 species, including 20 of economic importance, showing the species that feed on each. Although the larvae of some genera show a marked preference for certain groups of plants, others, notably *Achaea lienardi* and *A. catocaloides*, are polyphagous. The food-plants of *O. fullonia* and *O. divitiosa* are restricted to one family (Menispermaceae) but those preferred by either were in general rejected in the laboratory by the other. Larvae of *Anomis leona* sometimes damage the foliage and pods of cacao, and those of *Cosmophila* (*Anomis*) *flava*, F., the leaves of cotton and *Hibiscus esculentus* ; yam (*Dioscorea*) is attacked by larvae of *Heliophisma*, including, in the laboratory, *H. catocalina*. Very few adults were attracted to a light-trap operated in a *Citrus* plot in 1940, although swarms of moths, notably *Achaea* spp., are sometimes attracted to lights in houses in the Eastern Province. Eggs were generally found on the lower surface of the leaves of the food-plant. In general, the larvae are rarely numerous, and mortality is therefore thought to be high. The egg, larval and pupal stages lasted about 0·5, 3–3·5 and 2–3 weeks in most of the species studied. Pupation takes place between the leaves of the food-plant, and the pupae are rarely observed in the field except when the larvae have been abundant. In most of the species there are probably 6–8 overlapping generations a year. There was no evidence of a seasonal diapause (aestivation) and larvae are probably

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present throughout the year, although populations are greatest between May and August. Sudden outbreaks of large numbers of larvae of various species, occurred between the end of March and the end of April in 1940, and between mid-April and mid-May in 1941. These outbreaks, which apparently occur each year, were confined to a limited strip in the region of low annual rainfall along the coast. There appears to be little correlation between the abundance of the larvae and that of the adults collected, and the author suggests that this may be due to the fact that many larvae feed in the forest canopy, where collecting is impossible, and that possibly only a proportion of the total number of moths of each species pierce fruit.

Gorged adults of *Achaea leona* and *Heliophisma catocalina* were occasionally captured on *Citrus* by Mantids and spiders, but these, however, are of no importance in control. Twenty-five larval and pupal parasites, comprising 15 Hymenoptera, 9 Diptera and one Nematode, were reared from field-collected larvae, chiefly those from the forest zone. During the spring outbreak in the coastal region, parasitism was low in *Achaea* and the larger Noctuids, but was fairly high in *Anomis* spp., particularly *A. leona*. The most important parasites appear to be two Ichneumonids of the genus *Enicospilus*, of which the larger attacks *Heliophisma* spp. and *O. divitiosa*, and the smaller attacks *Cosmophila flava*, *A. leona*, *Dermaleipa parallelipipeda* and four species of *Parallelia*. Most of the Dipterous parasites were unidentified Tachinids that attacked the larvae but did not pupate until the host had done so. Of the two that appeared to be of greater importance than the rest, one parasitised *Achaea lienardi*, *Heliophisma catocalina*, *H. klugi*, Boisd., and *Pericyma mendax*, Wlk., and the other, which was more frequent in the coastal region than in the forest zone, parasitised *Serrodes trispila* and *Anomis* sp. No parasites of *O. fullonia* were found.

The data obtained for each species of Noctuid are summarised in the third part (pp. 36–55), and the fourth (pp. 56–59) comprises a discussion of the results of the survey. The presence of fallen fruit in the orchards did not appear to attract injurious species, and no one genus or species appears to be attracted by only one type of fruit. Although breeding continues throughout the year, the incidence of the moths as pests is seasonal and varies in different localities and from year to year. Most damage occurs between April and June, and it is most severe, and the moths most abundant, near the coast. Annual losses of 75 per cent. are usual in heavily infested regions. Control of the moths to a point at which they are of no economic importance appears to be impracticable, and the author therefore recommends measures designed to reduce the amount of damage. These include the encouragement of the cultivation of *Citrus* in the less heavily infested inland areas and prompt harvesting of the fruit; trees in small plantations can be protected by means of cheese-cloth tents, and bunches of fruit by means of small basket-work cages.

Meteorological data for Asuansi in 1939–41, tables showing the numbers of moths of each of the 12 more important species and the number of species represented in collections made each week from mid-April 1940 to the end of August 1941 and a map of the Gold Coast and southern Ashanti are appended.

NOTLEY (F. B.). **Report of the Entomologist.**—*6th Rep. Coffee Res. Exp. Sta. Lyamungu, Moshi 1939* (*Pamphl. Dep. Agric. Tanganyika* no. 27) pp. 19–23. Dar es Salaam, 1941. Price 1*s.* 6*d.*

Investigations at Moshi, Tanganyika Territory, on the coffee leaf-miners, *Leucoptera coffeella*, Guér., and *L. caffeina*, Wshbn., were continued in 1939 [*cf. R.A.E.*, A **29** 175]. The population of the former continued to fall until May, when less than one egg per tree was recorded. The percentage of the pupae parasitised by the Braconid near *Hormius* was 60–80 from February until

mid-April, but it suddenly fell to 40 at the end of April and to 20 in August, while the total percentage of larvae parasitised (chiefly by *Atoposoma variegatum* var. *afrum*, Silv.) decreased from 75 in February to 13 in early September. Accordingly, the population of *L. coffeella* increased from June until December, the numbers of eggs per tree reaching 370 by mid-December. The outbreak was then rapidly checked by parasites, however, among which *Apanteles bordagei*, Giard, was of more importance in the earlier stages than in the previous year [*cf. loc. cit.*]. It was less severe than the outbreak in 1938, probably because the phenomenon of " dominant stage " [a condition in which, at any given time, the majority of the insects are in the same stage of development] was less marked. The occurrence of this condition was demonstrated by recording the numbers of pupae collected at frequent intervals from September 1938 and from July 1939 that gave rise to adults or parasites, which indicated their relative abundance in the field. A series of peaks was thus obtained during the period of the increase of *L. coffeella* from May to November, at intervals that approximately equalled the periods necessary for the development of a generation at the appropriate temperature. The peaks represent times of relative abundance of pupae, and, if they correspond to the period of a generation, they indicate that the host is in the dominant stage, the intensity of which is indicated by the amplitude of the fluctuations. By tracing the peaks backwards, the dominant stage of the outbreak in 1939 was connected with that of 1938, and it is therefore considered possible that the dominant stage is a permanent phenomenon of *L. coffeella* at Moshi. This would suggest that this leaf-miner is not a pest that is normally controlled by its parasites and only occasionally goes into the dominant stage, but that it is always to some extent in that condition. The normal tendency of development is towards a multiple stage condition, but this is checked by differential parasitism, which thus lays the foundation of the next outbreak. On the other hand the occurrence of the dominant stage may be accidental, and the outbreaks (most of which occur in November–December) may be due to the curtailment of parasite activity during the cold season.

A very severe outbreak of *L. caffeina* on coffee under shade conditions occurred at the end of November 1939, the number of eggs per tree reaching nearly 3,500, but this was rapidly controlled in January. The records of the emergence of adults and for the collections of pupae showed the dominant stage fairly definitely. The number of eggs per tree remained at about 150 until May 1939, but had dropped to only 5 by mid-June ; there was a sudden rise to 350 in July, followed by a fall to 13 at the beginning of August, after which the outbreak developed, the number of eggs per tree rising to over 3,000 by the end of November. During February and March 1939, *Pleurotropis coffeicola*, Ferrière, and *Tetrastichodes leucopterae*, Ferrière, parasitised about 60 per cent. of all larvae, while *Hormius* sp. and *Ageniaspis* sp. parasitised a very variable number of cocoons, with an average of about 60 per cent. The percentage larval parasitism increased to 88 in April but then became negligible until September. After this it increased, resulting in the control of the outbreak in December and January 1940. *Eulophus borboricus*, Giard, was of some importance in November. The numbers of pupae in the collections that gave rise to adults or parasites showed marked fluctuations from the end of May. By inference from fluctuations in the egg counts, it appears that they may be a continuation of the dominant stage of the previous outbreak. It follows, therefore, that the dominant stage may occur permanently in *L. caffeina* also.

In dissecting the cocoons it was found that *P. coffeicola* occurs as a primary parasite of *L. coffeella* or *L. caffeina*, and also as a parasite of *Apanteles bordagei*, *Hormius* sp., *Ageniaspis* sp. and *Eulophus borboricus*, which may themselves be hyperparasitic.

A summary is given of observations on the seasonal occurrence of *Antestia* on coffee, a fuller account of which has already been noticed [*cf.* **29** 589].

MASON (F. R.). **Annual Report of the Department of Agriculture and Fisheries (Palestine) for the Year ended March 31, 1941.**—pp. 4–15. Jerusalem, 1941.

This report includes brief notes (pp. 12–14) on work in progress during the year ending 31st March 1941 in connection with insect pests of cultivated plants in Palestine. A survey in 1940 showed that *Pseudococcus comstocki*, Kuw., occurred on *Citrus* [*cf. R.A.E.*, A **29** 339] over a greater area than in 1939, but the infestation was generally less severe, apparently owing to hot dry weather in May. The unidentified species of *Pseudococcus* that damaged *Citrus* in 1938 and 1939 [*cf.* **28** 551] also became less abundant in infested groves, but it is spreading throughout the country; it has 5–6 generations a year. An Encyrtid parasite of the genus *Clausenia* [? *purpurea*, Ishii], which was introduced from Japan, is being bred on a small scale, and 10,000 adults have been liberated. Recoveries of it have been made in the field. The predacious Coccinellid, *Cryptolaemus montrouzieri*, Muls., has also been introduced for study in Palestine.

RAHMAN (K. A.) & ABDUL WAHID KHAN. **Bionomics and Control of** *Aeolesthes holosericea* **F. (Cerambycidae: Coleoptera).**—*Proc. Indian Acad. Sci.* Sec. B **15** no. 4 pp. 181–185, 2 refs. Bangalore, 1942.

This paper comprises a review of the distribution of the Cerambycid *Aeolesthes holosericea*, F., a list of the numerous trees from which it has been recorded in India, descriptions of all stages, and an account of observations on its bionomics and control in the Punjab, where its host-trees include apple, cherry, apricot, plum, peach, mulberry and walnut. The eggs are inserted into injured parts of the bark, and females laid a maximum of 92 at the rate of 1–5 a day. The larvae hatch in 7–12 days and feed at first on the inner layers of the bark and later on the outer layers of the sapwood also. They complete their development in 27–32 months, and then enter the wood to pupate. If they become fully grown by October, they pupate after 3–25 days, but if this does not occur till November the prepupal period may last 4½–5 months. The pupal stage lasts 40–100 days. If pupation occurs in October the adult remains in the stem throughout the winter and spring, but when it occurs in April, the adult rests for only about 6 weeks. Complete development from oviposition to adult emergence takes 31½–36 months. The adults cause little injury and fly at night.

Trees that are attacked can be recognized by the fibrous and faecal matter that falls from the larval tunnels. Young apple trees may be killed by a single larva. To prevent oviposition, injured bark and the bark near the ground should be painted with solignum. Young apple and cherry trees should be treated every summer. In 1940 all the larvae in 109 infested trees were successfully destroyed by scraping as much of the frass as possible out of the holes, introducing into them cotton-wool soaked in kerosene and sealing them with clay.

RAHMAN (K. A.) & ABDUL WAHID KHAN. **A Study of the Life-history and Control of** *Batocera horsfieldi* **Hope (Lamiidae: Coleoptera)—a Borer Pest of Walnut Tree in the Punjab.**—*Proc. Indian Acad. Sci.* Sec. B **15** no. 4 pp. 202–205, 1 pl., 1 ref. Bangalore, 1942.

The Lamiid, *Batocera horsfieldi*, Hope, all stages of which are described, is a serious pest of walnut in the Punjab. The adults emerge in June–July and survive for about 4 months. The females lay 55–60 eggs singly in the bark of the tree. The larvae hatch in 8–15 days and bore into the tree, feeding at first on the inner side of the bark and later on the outer sapwood. The larval stage lasts 20–25 months; the larvae less than a year old feed throughout the winter, but those fully-grown are inactive from October to March. The

prepupal and pupal stages last 50–182 and 46–90 days, respectively, and the adults remain in their pupal chambers for 5–6 months. Methods of control include killing the adults in June–October, destroying the eggs and the young larvae in their tunnels by probing with a knife or wire, and killing the older larvae by inserting into their tunnels potassium cyanide or cotton-wool soaked in paraffin and sealing the holes with mud.

NAZEER AHMED JANJUA. **On the Biology of Red Spider Mite (*Tetranychus telarius* Linn.) in Baluchistan.**—*Proc. Indian Acad. Sci.* Sec. B **15** no. 5 pp. 256–262, 9 figs., 5 refs. Bangalore, 1942.

Tetranychus telarius, L., has recently been observed in the hilly tracts of Baluchistan, from which it has not previously been recorded. It attacked many fruit trees, vegetables and ornamental plants, a list of some of which is given. All stages of this mite, its process of development and its manner of feeding are described. The time taken for the development of a generation was 22–28 days in winter and 9–12 days in summer, and in the Quetta Valley there are about 21 generations a year. The Coccinellid, *Adalia decempunctata*, L., and a species of *Chrysopa* are predacious on the mites at Quetta, but they are not sufficiently numerous to afford much control.

GADD (C. H.). **Observations on an Attack by Shot-hole Borer on Tea.**—*Tea Quart.* **14** pt. 4 pp. 132–146, 2 graphs, 6 refs. Talawakelle, 1941.

From an analysis of data obtained at Passara, Ceylon, at an elevation of 3,500 ft. by examination at intervals of three weeks between 7th February and 29th November 1940 of tea plants that had been pruned in November or December 1938, and from data in the literature, the author concludes that infestation by *Xyleborus fornicatus fornicatior*, Egg., does not become of economic importance during the first year after pruning and dies out during the third year, the main period of attack being usually in the latter half of the second year. Sufficient occupied galleries are always left after pruning to ensure an attack during the next pruning cycle, and such measures as the burning of prunings are of little or no use in preventing it. The cessation of attack during the third year is due to some factor or factors that cause an increase in the percentage of beetles that abandon the galleries before ovipositing [*cf. R.A.E.*, A **30** 232] and become increasingly deterrent as the attack progresses; they also result in an apparent reduction in the mean time of occupation of the galleries. During the period of heaviest attack, the number of galleries increased at the rate of 10·7 per cent. per week; the mean time of occupation was 11·7 weeks when there were few abandoned galleries, and healing was completed in an average of 8·4 weeks after the galleries became empty. It is considered that the adult females fly only short distances [*cf. loc. cit.*] and that the proximity of heavily infested tea is not a serious source of danger, since every susceptible field contains sufficient beetles to initiate the attack when the wood is suitable. Since mortality is heavy among the adults and in the galleries, it is doubtful whether the introduction of a parasite would be of any value.

BELL (A. F.). **Report of the Division of Entomology and Pathology.**—*41st Rep. Bur. Sug. Exp. Stas Qd* pp. 19–23. Brisbane, 1941.

In the year ending June 1941, the abundance of the larvae of *Dermolepida* (*Lepidoderma*) *albohirtum*, Waterh., again increased in several sugar-cane areas in Queensland [*cf. R.A.E.*, A **29** 388], but decreased in others owing to dry weather at the end of 1940. In the far north, the damage to cane was partly offset by the prolonged wet season and the early commencement of crushing operations. Injury was the heaviest for some years in the Mackay and Lower Burdekin areas. The only general flight of the beetles in the Mackay area occurred in January, but the infestation was subsequently favoured by

the wet autumn and the exceptionally dry winter. In the Lower Burdekin area, the main flight took place after heavy rains in early January, but there were earlier flights from irrigated fields. Soil-fumigation with carbon bisulphide was again restricted by lack of the fumigant and was delayed in some cases by the unfavourable distribution of the larvae in the interspaces, their slow approach to the stools, and the wet weather. The sweet variety S.J.2 constituted a considerable portion of the damaged unfumigated cane. It is unable to withstand even light attack by the larvae, and should not be planted where there is danger of infestation. In field experiments, several organic diluents of varying volatility were added to carbon bisulphide in an attempt to reduce the amount of fumigant used, but none of those tested was found to possess any toxicity to the larvae. Good results were obtained in many instances, however, by fumigating with less than the standard rate of $4\frac{1}{2}$ ml. carbon bisulphide [*cf.* **24** 273], especially when soil temperatures were high. In one test, a dose of $2\frac{1}{4}$ ml. was as effective as the full rate. Further campaigns for the elimination of trees that serve as food-plants for the adult beetles were undertaken [*cf.* **29** 388].

Larvae of *Lepidiota frenchi*, Blkb., caused serious damage in northern Queensland, particularly in cane-land that had been ploughed in the early spring and replanted. This practice should be avoided, since the larvae are then deep in the soil and cannot be reached by the plough ; they migrate to the upper layers in October and feed on the roots of the newly planted canes. Many heavily infested cane fields are bordered by Moreton bay ash [*Eucalyptus tesselaris*] or guava trees, which are favourite food-plants of the adult beetles, and the eradication of these trees would reduce infestation in districts in which no other adult food-plants are available. The beetles spend the day in the ground, and are accessible to the giant toad [*Bufo marinus*], one individual of which contained as many as 22 beetles in its stomach. These toads also feed on *Rhabdocnemis obscura*, Boisd. [*cf.* **29** 389], and may have accounted partly for the smallness of the damage caused by this weevil, in spite of the wet weather ; other contributing factors were the lateness of growth and the delay in the onset of top-root disease.

The wireworm, *Lacon variabilis*, Cand., was abundant in many fields in the Mackay district, but injury to the cane was avoided by the lateness of planting, owing to the wet weather. Observations during the year on the cane plots established in 1939 to test varietal resistance to *Aulacaspis madiunensis*, Zehnt., showed that the variety Comus is highly resistant ; only very small colonies of the Coccid occurred on Q.23 and Q.25, near which infested material had been scattered, and the infestation was general but light on Jason. The Coccids had spread throughout the plot under P.O.J.213 [*cf.* **29** 389].

Large populations of *Aphis maidis*, Fitch, developed as a result of the wet season, which rendered the destruction of weeds impracticable, and the spread of sugar-cane mosaic [*Marmor sacchari* of Holmes] was more rapid than usual, especially in the Bundaberg district. The variety Q.25 became infected to some degree, and is apparently too susceptible to be grown on much of the river-bank country.

Aphids in the quarantine house were satisfactorily controlled by the application to the soil of sodium selenate at a rate equivalent to 5 parts selenium per million parts soil.

BIRCH (L. C.) & ANDREWARTHA (H. G.). **The Influence of Moisture on the Eggs of *Austroicetes cruciata* Sauss. (Orthoptera) with Reference to their Ability to survive Desiccation.**—*Aust. J. exp. Biol. med. Sci.* **20** pt. 1 pp. 1–8, 3 figs., 18 refs. Adelaide, 1942.

In South Australia, the eggs of *Austroicetes cruciata*, Sauss., are laid in November and remain in the soil until the following September [*cf. R.A.E.*, A

26 584]. During this time, the eggs normally pass through a hot, dry summer and may be subject to desiccation. An account is given of laboratory experiments on the ability of the eggs to survive desiccation at different stages of development. It was shown that developing eggs can absorb water and that their water content rises slowly throughout development, with a sudden increase at the end of the period of diapause (about mid-May in the field), after which the increase is again gradual. The susceptibility of eggs to desiccation varies according to the stage of development of the embryo, being greatest for newly-laid eggs and least for eggs in diapause [*cf.* **30** 472]. When eggs in diapause are desiccated for periods of from one to seven months, the rate of mortality is dependent on total evaporation and the duration of exposure, a given amount of evaporation being more harmful if it is caused by a longer exposure. The elimination of diapause at the end of May, accompanied by an increase in water content, is followed by a sudden increase in susceptibility to desiccation, although no difference in the appearance of the sections of the egg membranes can be detected. Eggs in the post-diapause stage are more easily killed by desiccation than eggs in diapause; in all stages of development, however, prolonged exposure to low humidity is necessary to kill even 50 per cent. of the eggs. Some eggs in the experiment survived when the ratio of water content over dry weight was as low as 0·6, although the normal ratio varies from 2·13 to 3·14. Eggs containing embryos in an advanced stage of development could hatch at a relative humidity as low as 22 per cent. if they were in contact with a moist substratum. Nymphs hatching in dry soil are sometimes unable to lift the lid of the egg-pod until the surface of the soil becomes moist.

Birch (L. C.). **The Influence of Temperatures above the developmental Zero on the Development of the Eggs of** *Austroicetes cruciata* **Sauss. (Orthoptera).** —*Aust. J. exp. Biol. med. Sci.* **20** pt. 1 pp. 17–25, 1 graph, 22 refs. Adelaide, 1942.

Details are given of experiments in South Australia to find when the eggs of *Austroicetes cruciata*, Sauss., which are characterised by a diapause that inhibits development until they have been exposed to low temperatures, become able to respond normally to temperatures above the development zero [*cf. R.A.E.*, A **30** 472]. The observations were made on eggs collected in the field between February and July 1940. None of several thousand in the early stage of diapause hatched when incubated at constant temperatures of 25–30°C. [77–86°F.]. During February and March, only slight development of the eggs took place in the field, but eggs collected during these and subsequent months continued to develop in the laboratory at 30°C. From March until the end of April a progressive development of the embryo took place, both in the field and at 30°C. Diapause was thus gradually being eliminated from February onwards. The first eggs to hatch in the laboratory when incubated at 18·9–27°C. [66·02–80·6°F.] were some of those collected in mid-May, and 8 per cent. of those collected in late May were the first to hatch at 30°C., while of the eggs collected two weeks later, 90 per cent. hatched at the same temperature. The percentage of eggs able to hatch at 30°C. rose from 0 to 60 within a fortnight, while little, if any, morphological development of the embryo took place. Normality with respect to development at temperatures above the development zero (about 8°C. [46·4°F.]) was reached by the entire field population of eggs in mid-June. In Orroroo, which lies at a greater altitude and has lower temperatures, the diapause was eliminated earlier than at Wilmington, but by the end of May the percentage hatch and the mean time required for hatching at 30°C. were practically the same for eggs from both localities.

The curves showing the relation between temperature and the rate of development of post-diapause eggs are sigmoid and do not conform to any simple equation. At 13·5°C. [56·3°F.], the rate of development is slow,

averaging 0·9 per cent. per day for short exposures, and 0·7 per cent. for longer ones. One egg out of 150 collected on 29th May hatched after 138 days at 13·5°C. ; the rest were fully developed but did not hatch until removed to a higher temperature. The true zero of development was found to be in the vicinity of 8°C., but some development was observed after five weeks at that temperature. When post-diapause eggs were incubated on alternate days at two temperatures within the range 16·1–30·5°C. [60·98–86·9°F.], the rate of development at each temperature was the same as when the eggs were incubated at these temperatures constantly [*cf.* **25** 43]. The rates of development of eggs incubated at relative humidities ranging from 70 to 100 per cent. were practically the same.

Coe (R. L.). *Camarota curvipennis* **Latreille (Dipt., Chloropidae), and its Misquotation.**—*Proc. R. ent. Soc. Lond.* (B) **11** pt. 9 p. 141, 7 refs. London, 1942.

References to the literature are given in which *Camarota curvipennis**, Latr., has been misquoted by several authors as *C. curvinervis*.

Memoria de los trabajos realizados por la Estación de Fitopatología agrícola de La Coruña, años 1939–40. [The Work of the Phytopathological Station of Corunna in the Years 1939–40.]—*Publ. Estac. Fitopat. agric. La Coruña* no. 14, 54 pp., text ill. Corunna, 1941.

In the Report of the Entomological Laboratory (pp. 7–18) on work on the control of insect pests in Galicia in 1939 and 1940, it is stated that *Cryptolaemus montrouzieri*, Muls., was introduced from Valencia against *Pseudococcus citri*, Risso, on grape-vines in the Ribadavia district. Seven colonies of the Coccinellid were released in the spring of 1940, but the mealybug was still spreading at the time of writing. Since 1934, 1,657 colonies of *Aphelinus mali*, Hald., have been liberated against *Eriosoma lanigerum*, Hsm., in over 80 per cent. of the apple-growing districts. The results have varied from complete eradication, sometimes followed 3–4 years later by reinfestation, to total failure, which is often due to unfavourable weather immediately after the liberation. In most cases, however, there has been a considerable and permanent reduction in infestation. The parasite is favoured by its high rate of reproduction, but the adults are often destroyed by winter and spring rains, which do not affect the Aphid. The distribution of the parasite in Galicia is shown on a map. Potatoes were seriously injured in 1940 by larvae of *Peridroma* (*Lycophotia*) *saucia*, Hb., which fed on the aerial parts and caused the growth of the tubers to be arrested. Spraying with 0·5 per cent. lead arsenate was advised. The information given on the outbreak of *Lema melanopa*, L., on wheat in 1938–39 has been noticed from another source [*R.A.E.*, A **29** 463].

In the Report of the Cryptogamic Laboratory (pp. 19–40), a description is given of an unidentified species of *Empusa* observed developing on Aphids and killing over 80 per cent. of a species infesting artichoke. Experiments on artificial infestation of various Aphids by this fungus gave inconclusive results.

Bredenkamp (J.). **Zur Kenntnis der Wirkungsweise der Kontaktgifte mit besonderer Berücksichtigung der Permeabilität der Insektencuticula.** [A Contribution to the Knowledge of the Action of Contact Poisons with special Reference to the Permeability of the Insect Cuticle.]—*Z. angew. Ent.* **28** pt. 4 pp. 519–549, 6 figs., 37 refs. Berlin, 1942.

An account is given of laboratory investigations in Germany to ascertain how and under what conditions a contact insecticide placed on the integument of an insect penetrates the cuticle, and the literature on this subject is reviewed

* By an unfortunate oversight, the name was spelt *curviventris* instead of *curvipennis* in a recent footnote [*R.A.E.*, A **30** 405].—*Ed.*

in detail. The author considers that the cuticle comprises an inner, main layer, or endocuticle (of which the exocuticle is part) and an outer layer, or epicuticle. The latter consists of a complex combination of fatty acids and waxes, and contains no albumen or chitin, such as occur in the outer portion (exocuticle) of the endocuticle. No differences were observed in the structure of the epicuticle from the same parts of the body of larvae of *Dendrolimus pini*, L., *Lymantria monacha*, L., *L. dispar*, L., *Trochilium apiforme*, Cl., and *Macrothylacia rubi*, L.

In experiments with larvae of the first four of these moths and *Pyrausta nubilalis*, Hb., the amounts of water that evaporated through pieces of untreated cuticle and pieces treated in various ways were measured, and it is concluded that differences in these amounts depend less on the epicuticle than on the structure of the layers beneath it. When the epicuticle was separated from the other layers and subjected for 5 days to the action of various contact dusts and sprays, it was not affected by any of them and must therefore be permeable, since the poisons evidently penetrate without injuring it.

Experiments on the effect of temperature and moisture on the penetrating power of the poisons were carried out with larvae of *L. monacha*. When larvae that had been kept for 18 days at various temperatures and humidities were dusted with pyrethrum, barbasco root (5 per cent. rotenone) and Detal (dinitro-ortho-cresol), the intervals that elapsed before symptoms of poisoning were observed were longest for the lowest temperatures and relative humidities, and shortest for the highest ones, and humidity appeared to be more important in this connection than temperature. When larvae were kept at about 21°C. [69·8°F.] and 30 or 100 per cent. relative humidity during dusting, pyrethrum and Detal acted in 518 seconds and 172 minutes, respectively, at the lower humidity, and in 364 seconds and 143 minutes at the higher one. In a third experiment, larvae that had been kept for 8 days at 21·5°C. [70·7°F.] and 30 or 100 per cent. relative humidity were sprayed with atomised water before being dusted with pyrethrum and Detal, and control batches were dusted without wetting. In the 30 per cent. series, the periods before toxicity became evident in the wetted and unwetted larvae were 378 and 419 seconds for pyrethrum and 117 and 173 minutes for Detal. In the 100 per cent. series, these periods were 371 and 392 seconds for pyrethrum and 91 and 159 minutes for Detal. When half the amount of Detal was applied, the periods were considerably prolonged, but were still shorter for wetted larvae than for unwetted ones that had received the full quantity of poison. Thus, high relative humidities before and during dusting only slightly accelerated the action of the poisons, but direct wetting of the cuticle distinctly hastened the action of Detal, presumably by providing a greater quantity of solvent on the surface of the body. It must be remembered, however, that a high relative humidity increases the resistance of the larvae to poisoning.

In further experiments, the cuticle was removed whole from living larvae and tested for its permeability to various substances. Those having great surface activity (alcohols, aldehydes, ethers, esters of organic acids) penetrated easily, but those possessing little surface activity (amino acids, disaccharides) passed with difficulty or not at all. Fatty oils and paraffins generally failed to pass, even when dissolved in organic solvents. In experiments with cuticle from the dorsum of larvae of *L. monacha*, *L. dispar*, *D. pini*, *M. rubi*, *T. apiforme* and *Bombyx mori*, L., chemical proof was obtained that Detal, nicotine, rotenone, arsenic trioxide, potassium arsenate and arsenic pentoxide pass through the cuticle, and these substances did not appear to have undergone any change in the process of penetration. Stain reactions demonstrated the presence of permeable areas in the cuticle, including that of a living larva of *B. mori*. They occurred chiefly in the membranes of the pores of the setae but were also distributed over the whole skin. It is highly probable that permeability is a purely mechanical process.

HASE (A.). **Köderungsversuche mit Kleidermotten.** [Bait Experiments with Clothes Moths.]—*Z. angew. Ent.* **28** pt. 4 pp. 550–570, 4 figs., 21 refs. Berlin, 1942.

Experiments were carried out in 1938–40 to investigate a claim that the powdered dried flowers of *Helichrysum arenarium*, which are known as Flores Stoechados and are used in medicine, attract clothes moths [*Tineola biselliella*, Humm.]. Pieces of woollen material bearing small amounts of the powder were exposed for periods of up to two years in rooms known to be heavily infested with moths, together with control materials. All the pieces of material were attacked, but those bearing the powder were injured to a greater extent than the untreated ones, though not more than those bearing a nutritive medium used for laboratory breeding. It is pointed out that the powdered flowers alone are not a suitable food for the larvae and are not attractive to the moth.

MÜLLER-KÖGLER (E.). **Laboratoriums- und Freilandversuche mit Kiefernspannerraupen und zwei insektentötenden Pilzen.** [Laboratory and Field Experiments with Larvae of *Bupalus piniarius* and two entomogenous Fungi.]—*Z. angew. Ent.* **28** pt. 4 pp. 613–645, 14 figs., 16 refs. Berlin, 1942.

The experiments described were carried out in Prussia in 1938–39 to determine whether the entomogenous fungi, *Spicaria farinosa* var. *verticillioides* and *Beauveria bassiana*, could be used for the control of *Bupalus piniarius*, L. They were first applied to apparently healthy fifth-instar larvae in the laboratory, at room temperatures (which were between 5 and 12°C. [41 and 53·6°F.]) and constant relative humidities of 100, 94, 78, 60, 34, 17 and about 0 per cent., and the larvae were given pine needles as food. Observations on control larvae showed that the optimum humidity was between 94 and 100 per cent. At all humidities except the two lowest, the percentage mortality among the treated larvae was distinctly greater than that among untreated ones. The differences were slight at the two lowest humidities, but these caused increased mortality of the control larvae. Relative humidities greater than 60 per cent. favoured germination of the spores, and the periods within which the larvae died decreased as humidity increased. These periods also decreased at low humidities, which were unfavourable to the fungi and to the larvae themselves. Infections were difficult to obtain at a relative humidity of 60 per cent., which is usual in forests, but the percentage mortality reached 70.

In the tests on the influence of temperature, larvae dusted with the spores were kept at 0·5°C. [32·9°F.], 8°C. [46·4°F.], 16·5°C. [61·7°F.], 18·5°C. [65·3°F.] and 24°C. [75·2°F.] or 25°C. [77°F.] in a saturated atmosphere. Infections with *Spicaria* succeeded at all temperatures, but those with *Beauveria* failed at 0·5°C. and mortality was delayed at 8°C. At 18·5° and 25°C., larvae infected with *Beauveria* died more quickly than those attacked by *Spicaria*. In general, the periods within which 66·6 per cent. mortality was obtained were inversely proportional to temperature and were least (some 3–5 days) at 25°C. The appearance of infected larvae is described in some detail.

In October 1939, forest tests were made with batches of larvae on young pine trees about 5ft. in height. Each tree was enclosed in a cage and its trunk passed through the middle of a cloth stretched on a square frame supported on posts. A band of adhesive round the edges of the frame was intended to prevent the larvae from escaping, but some did so. A batch of 50 larvae was introduced into each cage, and the larvae were infected with the fungi by shaking them up or dusting them several times with the spores or by spraying them in the cage once or several times with a suspension of spores. The trays were examined daily and the observations are recorded in detail. The temperature gradually

fell during the experiment, and a frost occurred after 13 days. Up to this time, mortality had been slight in all the cages, but it increased rapidly after the frost and was greatest among the larvae that had been shaken up with the spores and had become heavily covered with them. The assumption that infection as well as cold was responsible for the mortality was supported by an experiment in which infected and uninfected larvae were exposed for 4 hours to —5°C. [23°F.] ; the percentage mortalities among the two groups were 32 and 4, respectively. The author concludes that larvae in forests can be infected with entomogenous fungi, but that further investigation is necessary before their practical use becomes feasible.

Stone (A.). **The Fruitflies of the Genus** *Anastrepha.—Misc. Publ. U. S. Dep. Agric.* no. 439, 112 pp., 23 pls., 22 figs., 10 refs. Washington, D.C., 1942.

This revision of the genus *Anastrepha* includes descriptions of 126 presumably valid species, of which 52 are new, a key, based, with a few exceptions, on the females only, to all but 15 of them, of which the identity is uncertain or only males are known, and a list of species incorrectly included in the genus. The economic importance and geographical distribution of these fruit-flies are discussed, and a list is given of host-fruits found in field or market infestations ; these are known for only 44 of the species.

d'Araujo e Silva (A. G.) & de Almeida (D. G.). **Entomologia florestal. Contribuição ao estudo das coleobrocas.** [Forest Entomology. A Contribution to the Study of the Coleopterous Borers.]—*Publ. Dep. nac. Prod. veg. Minist. Agric. Brasil* no. 16, 100 pp., 21 pls., 33 refs. Rio de Janeiro, 1941.

Notes are given on the morphology, distribution, bionomics and food-plants of nine Longicorns and three other Coleoptera that tunnel in the wood of trees of economic importance in Brazil ; some of them attack more than one of these trees. The injury caused consists mainly in depreciation of the timber.

Adamson (A. M.). **Mole-cricket Parasites of the Genus** *Larra* **in Trinidad.**—*Trop. Agriculture* **19** no. 3 pp. 43–45, 5 refs. Trinidad, 1942.

In Trinidad, where the mole-crickets, *Scapteriscus vicinus*, Scud., and *Gryllotalpa hexadactyla*, Perty, are very destructive in vegetable gardens and lawns, examples of three Sphegid parasites of the genus *Larra*, which has not hitherto been recorded from the Island, were taken or observed during 1936–41. These insects comprised two females of *L. guiana*, Cam., and two further adults probably belonging to this species, one male of *L. americana*, Sauss., and one female of *L. transandina*, Williams. It was evident that the parasites were very rare or localised. Brief notes are given on their bionomics based on observations on one female of *L. guiana* and two generations of its progeny and on two generations of *L. americana* reared from a few females that were imported from Brazil in 1937, before it was known to occur in Trinidad. The habits of both species were found to be very similar to those of *L. analis*, F. [*cf. R.A.E.*, A **23** 554]. *L. guiana* oviposited and developed successfully on examples of *S. vicinus*, which died about 16 days after the parasite eggs were laid (or about 10 days after they hatched), and a female that had recently attacked *S. vicinus* paralysed an adult of *G. hexadactyla*, but did not oviposit on it. *L. americana* oviposited on the two mole-crickets with equal readiness ; it developed successfully on *Scapteriscus*, which died 17 days after the deposition of the parasite eggs, but all examples of *Gryllotalpa* died a few days after capture, so that the ability of the parasite to develop on them was not determined.

Burnham (J. C.) & MacLeod (D. J.). **Varietal Susceptibility of Potatoes to Aphid Injury.**—*Canad. Ent.* **74** no. 2 p. 36. Guelph, Ont., 1942.

Experiments in New Brunswick on the resistance of certain varieties of potato to virus diseases transmitted by *Myzus persicae*, Sulz., were hampered by the similarity of the injury caused by the feeding of the Aphid and that caused in susceptible varieties by Solanum viruses 2 and 3 [*Marmor cucumeris* var. *upsilon* and *M. solani* of Holmes]. A more detailed study of direct injury to potatoes by the Aphid was therefore undertaken, and experiments under field and cage conditions over a period of three years showed that commercial varieties differ in susceptibility as indicated by injury to the leaves and by weight of tubers. The most resistant variety never suffered serious foliage injury, and the Aphids never became very numerous on it ; the least resistant variety was so severely injured that the plants died in little more than four weeks after infestation.

Daviault (L.). **Description et biologie de deux lépidoptères nuisibles à l'orme.**—*Nat. canad.* **69** no. 6–7 pp. 145–157, 2 figs., 4 refs. Quebec, 1942.

The Notodontids, *Heterocampa bilineata*, Pack., and *Nerice bidentata*, Wlk., all stages of which are described, caused serious defoliation of elm at Berthierville, Quebec, in 1937. *H. bilineata* hibernates in the larval stage in a cell in the soil and pupates in the spring ; the adult emerges about 15 days later. In the laboratory most of the adults emerged in June. The eggs are deposited singly on the lower surface of the leaves and hatched in the laboratory in 10·5 and 7 days at average temperatures of 60·8 and 63·4°F., respectively. The larvae feed in the leaves for 25–35 days and then drop to the ground and enter the soil, where they either pupate in a short time or remain in diapause until the following spring. The duration of total development without a diapause is about 55 days, but there is usually only one generation a year in Quebec. If the summer is hot, however, as it was in 1937, there may be two. In 1937 about 11 per cent. of the larvae were parasitised by the Eulophid, *Comedo brevicapitatus*, Cook & Davis.

N. bidentata hibernates in the pupal stage in a cocoon attached to fallen leaves. In the laboratory the adults emerged in May and the first half of June. The eggs are laid singly on the lower surface of the leaves, and the egg, larval and pupal stages lasted 9, 32 and 13 days, respectively. Since larvae were numerous on elms in the late summer of 1938, it is concluded that there are two generations a year in Quebec.

Blackman (M. W.). **Revision of the Bark Beetles belonging to the Genus *Pseudohylesinus* Swaine.**—*Misc. Publ. U. S. Dep. Agric.* no. 461, 32 pp., 3 figs. Washington, D.C., 1942.

This revision contains descriptions of the nine known species of *Pseudohylesinus* and of seven new ones, together with a key to them and records of their distribution and of the trees they attack. The range of the genus extends from Alaska to Panama and in the United States it is confined to the western forests. These Scolytids attack conifers, mostly species of *Abies*, but are not of great economic importance. Several species do attack and destroy apparently normal trees, but the preferred breeding sites comprise recently-felled trees, decaying trees, trees that have been blown down by the wind and, in some species, trees that are dying or have recently died as a result of attack by other insects. Trees that are blown down frequently have only a small part of their roots severed and remain alive for years unless infested by insects. Such trees are generally quickly attacked by *Pseudohylesinus*, and several species may infest the same tree at about the same time, some breeding in the trunk, others in the larger branches and yet others in the smaller ones.

McKenzie (H. L.). **New Species of Pine-infesting Margarodidae from California and southwestern United States (Homoptera ; Coccoidea ; Margarodidae).**—*Microentomology* **7** pt. 1 pp. 1–18, 7 figs., 2 refs. Stanford Univ., Calif., 1942.

Descriptions are given of two new genera and five new species, for which a new tribe, Pityococcini is erected, found on pines in the United States in association with species of *Matsucoccus* [*cf. R.A.E.*, A **30** 1, 434], which they closely resembled in appearance and habits. They comprise *Pityococcus ferrisi* on *Pinus monticola* and *P. lambertiana* in California, *P. edulis* in Arizona and *P. flexilis* in Utah and probably on *P. cembroides* in Texas ; *Pityococcus deleoni* from *Pinus parryana* (*quadrifolia*) in California ; *Pityococcus rugulosus* on *Pinus edulis* in Arizona ; *Desmococcus captivus* on *P. monophylla* in California ; and *D. sedentarius* on *P. monophylla* and *P. edulis* in Arizona. Keys are given to the females of the new genera and to the females and (except in the case of *Pityococcus rugulosus*) to the larvae of the new species.

McKenzie (H. L.). **Seasonal History of the Margarodid Scale, *Matsucoccus bisetosus* Morrison, occurring on Ponderosa and Jeffrey Pines in California (Homoptera ; Coccoidea ; Margarodidae).**—*Microentomology* **7** pt. 1 pp. 19–24, 2 figs., 1 ref. Stanford Univ., Calif., 1942.

Some of the information given in this paper on *Matsucoccus bisetosus*, Morrison, which occurs on *Pinus ponderosa*, *P. jeffreyi* and allied pines in California, Oregon, Arizona and Colorado, has already been noticed [*R.A.E.*, A **30** 434]. Laboratory studies on the bionomics of this Coccid, the stages of which are described, were made in California in 1940–41. The females become adult and the males pupate after two larval stages, of which the second is apodous and is termed intermediate by the author. Winter is passed in the intermediate larval stage, and the adults emerge in March or April. After a short migration under the bark scales, generally towards the tip of the smaller twigs, during which mating takes place, the female settles along the twig or in the twig axils. Oviposition continues for about two weeks, and females deposit an average of 194 eggs. The larvae hatch in 20–31 days, usually during April in northern California, and after crawling about under the bark scales become fixed, generally beneath a bark plate on the stem or in a twig axil, and start to feed. They become full-grown in February of the following year. There appears to be only one larval moult in this species, though in *M. vexillorum*, Morrison, which attacks *P. scopulorum* in Arizona, there are two.

Although large numbers of *M. bisetosus* were reared, no parasites were obtained; a Cecidomyiid was observed to prey on the Coccids, but it exerts little control. The principal control factor appears to be the pressure exerted on the immature stages, especially the intermediate larval stage, by the bark scales, either as a result of the growth of the tree or of the growth of the Coccids themselves. Flattened and dead females that had completed their development were often observed within the larval skins. This phenomenon has also been noted in *M. californicus*, Morrison, which attacks the boles of mature *Pinus ponderosa* and *P. jeffreyi* in California.

Hall (R. C.). **Control of the Locust Borer.**—*Circ. U. S. Dep. Agric.* no. 626, 19 pp., 14 figs., 2 refs. Washington, D.C., 1942.

The following is substantially the author's summary. This circular deals largely with the protection of young plantations of the black locust tree (*Robinia pseudacacia*), which is being extensively planted in the United States to bind the soil on eroded lands, against the larvae of *Cyllene robiniae*, Forst., which make large tunnels in the sapwood and heartwood, thus rendering the wood useless for posts or construction work and often causing the trees to break

and fall. The eggs of this Cerambycid are laid in autumn in rough crevices of the bark or round wounds, and the larvae overwinter in the inner bark and bore into the wood in the following summer.

Recent investigations, carried out over seven years in Ohio, showed that there is a very close relation between the condition of the trees and injury by the borer [*cf. R.A.E.*, A **22** 304]. The most thrifty trees are the least damaged, and factors that reduce the vigour of the tree, such as drought, fire and grazing of livestock, tend to increase its susceptibility. Certain silvicultural methods, designed to improve growing conditions, showed considerable promise as a means of control. They included clear-cutting, thinning, mulching and the use of mixed plantings. Of these, clear-cutting appears to be useful in slowly growing stands where cutting of the trees is followed by very rapid growth in the sprouts that develop from the stumps. Thinning is applicable in more rapidly growing stands, where the highly susceptible understory trees are removed to reduce the borer population and to favour growth of the residual stand by reducing competition for light, moisture and soil nutrients. Mixed planting of new plantations is promising if the soil will support other broad-leaved trees. Mulching with hardwood leaves is limited, because of its cost, to trees of high value, but mulching effects may be obtained by interplanting black locust in existing open-park woods. The use of superior varieties of black locust appears to offer some promise of control. Woodpeckers are the most important of the natural enemies observed, but are effective only locally. Orthodichlorobenzene emulsion is the most promising spray material [*cf.* **20** 529], but it is too expensive for general use.

Gray (K. W.) & Schuh (J.). **Pea Aphid Control in Oregon.**—*Bull. Ore. agric. Exp. Sta.* no. 389, 23 pp., 11 figs. Corvallis, Ore., 1941.

In further work in Oregon in 1940 on dusts for the control of *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) on peas [*cf. R.A.E.*, A **28** 614], use was made of a small power duster that was attached to the front of a motor car and applied the dust to two sides of the tips of the plants. It had a new type of hood that prevented the Aphids from escaping contact with the dust if they dropped to the ground. The results were based on counts, made 4 days after treatment, of samples taken by a method already noticed [*cf.* **30** 188]. The insecticides tested in the dusts were chiefly rotenone (as cubé, derris or timbo), pyrethrins and nicotine, and the conditioners used comprised oils of plant, animal and mineral origin, wetting agents and an activator (Graselli activator 834A7) containing a vegetable oil, an emulsifier, a thiuram sulphide and such blending agents as necessary to produce a non-separating mixture. The results showed that a dust containing 0·75 per cent. rotenone and 3 per cent. soy-bean oil, applied at about 35 lb. per acre, was the most effective. The increase in yield was highly significant, and the Aphid population did not regain its original numbers for 20–25 days after dusting. This dust gave as good control in a subsidiary test as atomised oils, and the addition of 1·45 per cent. nicotine to the latter did not make them more effective. There was no advantage in increasing the concentration of the rotenone or of the oil in the dust, and several other oils gave as good results [*cf.* **28** 615], though pine oil, coconut oil and mineral oil (Standard Oil no. 4, viscosity 50–55 seconds Saybolt and 90 per cent. unsulphonation test) did not. A highly significant increase in the control of the Aphid resulted from the employment of the new hood design as compared with an apparatus approximating to the type previously in use.

The dust of rotenone and vegetable oil can also be used to control the Aphid on trellis peas, but the amount to be applied should be varied from 30 lb. per acre for plants up to 2 ft. high to 50 lb. for those 6 ft. high. Care should be taken to dust the lower surfaces of the leaves and the tops of the plants. A rotenone spray can also be used on trellis peas, that recommended after four

years' investigations being 1·66 lb. cubé, derris or timbo containing 4 per cent. rotenone per 100 U.S. gals., with a wetting agent. Sulphur may also be added for the control of powdery mildew.

McClure (H. E.). **Spring Aphid Aero-plankton (Homoptera).**—*Ent. News* **53** no. 3 pp. 67–70, 1 ref. Philadelphia, Pa., 1942.

A table is given showing the numbers of 27 species of Aphids taken on various dates between 1st May and 19th June 1934 in Kentucky by means of a net attached to the fender of a motor car. *Rhopalosiphum prunifoliae*, Fitch, *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.), *Pemphigus lactucae*, Fitch, and *Toxoptera graminum*, Rond., constituted 21, 14, 11 and 7 per cent., respectively, of the total. The collections were made between 6 and 8 a.m. and between 6 and 7 p.m., and the numbers of Aphids caught in the evenings were more than double those taken in the mornings. In the morning, the greatest flight activity occurred from 30th May to 2nd June, and the period of spring migration appeared to last from 27th May to 7th June. This vernal flight was associated with rising daily temperature and humidity.

Hanson (A. J.) & Webster (R. L.). **The Carrot Rust Fly.**—*Bull. Wash. agric. Exp. Sta.* no. 405, 24 pp., 10 figs., 9 refs. Pullman, Wash., 1941.

Psila rosae, F., was first recorded in Washington in 1908, but did not become a pest there until 1928–29. Short accounts are given of its bionomics and distribution in the United States, and the types of injury it causes to carrots, celery, parsnips and parsley, which are its principal food-plants, and all stages are briefly described. In Washington, injury to carrot by first-generation larvae becomes apparent in early June and by second-generation larvae in late August or early September. The fly overwinters as a larva in the carrots or as a pupa in the soil. Adults of the overwintered generation emerge from April until the beginning of June, with a peak in the second and third weeks of May. The eggs are deposited in the soil and hatch in 4–7 days, and the larvae feed for about a month and pupate in July. First-generation adults appear about 15th July and are present until the end of the season ; they survived in an outdoor insectary until January. The resulting larvae are more numerous than those of the first generation. Mortality is high during the winter, and damage by first-generation larvae in the following year is consequently slight.

Damage to early carrots by second-generation larvae can be avoided by harvesting the crop before 1st September, and damage to main-crop carrots can be reduced by delaying sowing until late May or early June so that the first generation does not develop on them and they consequently escape infestation by the second, provided that there are no early carrots in adjoining fields. If infestation is severe at harvest time, the succeeding crop should be treated with crude naphthalene. In field trials with various insecticides on early and main-crop carrots in 1936 and 1937, naphthalene flakes broadcast as a repellent afforded the most effective control. Over 95 per cent. control of the first-generation larvae was given in both years by two applications at weekly intervals in late May at the rate of 100–400 lb. per acre, 300 lb. being apparently the most effective (99·4 and 99·9 per cent. control), and over 92 per cent. control of the second-generation larvae was given by five applications at weekly intervals in August at the rate of 300 or 400 lb. per acre in 1936 and by an application at the end of July followed by five at weekly intervals during August at the rate of 100 lb. per acre in 1937. Five applications at the rate of 50 and 100 lb. per acre were ineffective. Other treatments that gave a marked reduction in infestation by the first-generation larvae but were so inefficient against the second generation that they are considered unsatisfactory were Bordeaux mixture (4 : 4 : 50) and 1 per cent. oil emulsion, separately or in combination, magotite (prepared

by dehydrating the sludge obtained as a by-product in the manufacture of coal-gas and stated to contain all the coal-tar derivative, including cresylic acid and naphthalene), and mercurous chloride (calomel) and mercuric chloride (corrosive sublimate), both at the rate of 1 oz. in 8 U.S. gals. water. A dust containing creosote and hydrated lime (1 : 10) gave 90·3 per cent. control of the second-generation larvae. Only 26·1 per cent. control of this generation resulted from five applications of a derris dust containing 0·75 per cent. rotenone [*cf. R.A.E.*, A **27** 497]. String impregnated with creosote, naphthalene, paradichlorobenzene, or naphthalene and paradichlorobenzene and stretched along the base of the plants when the adults were abundant gave good control, ranging from 94·6 to 98·4 per cent., of the first-generation larvae, creosote being the most effective material, but was of no value against the second generation in either year.

McDaniel (E. I.). **Strawberry Root Weevils and Crickets as Household Pests.**—*Ext. Bull. Mich. St. Coll. Agric.* no. 230, 4 pp. East Lansing, Mich., 1941.

Adults of *Otiorrhynchus* (*Brachyrrhinus*) *ovatus*, L., often enter houses in Michigan in late summer or early autumn to hibernate, but do no damage. The larvae develop in the soil and can be controlled by treating it with lead arsenate at the rate of 10 lb. per 1,000 sq. ft. If a new lawn is being established, the poison should be applied after the ground is prepared for seed, but on old lawns or established plantations, it should be applied in three or more treatments at intervals of 2–6 months. The adults can be controlled by a bait containing sodium arsenite [*cf. R.A.E.*, A **23** 111], or one prepared by mixing 4 oz. white arsenic or Paris green and 1 U.S. pint molasses with 1 U.S. quart water, stirring the mixture into 5 lb. bran and adding ½ teaspoonful oil of apple (amyl valerate).

Gryllulus (*Gryllus*) *domesticus*, L., occasionally invades buildings and feeds freely on any material containing wool. The crickets can be controlled by dusts of sodium fluoride, powdered borax, pyrethrum or rotenone, the first of which should be used only in protected places, or with baits similar to those recommented against *O. ovatus* with the addition of about 12 oz. salt to the quantities given and preferably with amyl acetate substituted for amyl valerate.

Munro (J. A.) & Telford (H. S.). **Crop Rotations and Wireworm Injury to Potato Tubers.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* **4** no. 3 pp. 21–23, 1 ref. Fargo, N. Dak., 1942.

The percentages of potato tubers that were damaged by *Corymbites* (*Ludius*) *aeripennis destructor*, Brown, in 67 fields in North Dakota were estimated during 1940 and 1941 in an attempt to correlate wireworm injury with crop rotation. They varied from 0 to 77, and the fields were divided into four categories according to the percentage in each. The cropping history of the fields in the years 1936–40, inclusive, was investigated, and data for 240 crop-years were thus made available. It is believed that the frequency (expressed as a percentage of crop-years) with which a particular crop or summer fallow occurs in each category of injury can be taken as a measure of the degree to which it favours subsequent infestation by wireworms. The results of the analyses are shown in tables. The percentages of crop-years represented by summer fallow in the four categories of injury (0–19, 20–39, 40–59 and 60–79 per cent. tubers damaged) were 16·6, 5·3, 8·1 and 0, respectively, those represented by potatoes were 16·7, 24·7, 21·6 and 37·5 and those represented by small grains were 55·1, 61·4, 48·5 and 50. It is concluded, therefore, that infestation is favoured by potatoes, discouraged by summer fallow and not much affected by small grains. In a total of 26 fields in which summer fallow had been practised and 41 in which it had not, the percentages of tubers injured were 14 and 22·7.

The conclusions drawn from the work are that summer fallow should be practised whenever possible, that potatoes should not be grown continuously on the same land, and that a rotation of potatoes and small grains is not to be recommended, since infestation is encouraged by the former and maintained by the latter.

LONG (T. E.) & CROPSEY (M. G.). **Grain Storage on the Farm.**—*Bull. N. Dak. agric. Exp. Sta.* no. 302, 68 pp., 54 figs., 7 refs. Fargo, N. Dak., 1941.

The first half of this bulletin comprises sections on the structural requirements for safe storage of wheat, the selection and conditioning of wheat for storage, and precautions for storage over a period of time, together with one, by J. A. Munro (pp. 29–32), in which brief notes are given on the appearance of the insect pests of importance in stored grain in North Dakota, precautions against infestation and the use of fumigants for control. In the second half are given the results of experiments in the State with different types of bins and ventilation systems, and on the effects of moisture content and weather conditions on stored wheat.

PARKER (J. R.). **Annual Insect-damage Appraisal.**—*J. econ. Ent.* **35** no. 1 pp. 1–10, 27 refs. Menasha, Wis., 1942.

In view of the necessity due to war expenditure for economy in all non-essential activities in the United States, the author considers that economic entomologists there should call attention to the value of insect control and research, showing the yearly damage before control and research were carried out, the reduction in damage and the resulting savings accomplished by money already spent and the possibility of still greater savings from continued and intensified control and research programmes. He points out the questionable value of past statements of annual insect damage ; emphasises the need for a sound, scientific method of appraising annual losses caused by insects in order to give the public a better basis for judging the importance of economic entomology, to account for the public funds already spent and to ensure that they are spent on the most profitable control measures in the future ; and discusses the type of organisation needed for such work. An annual review of insect damage and abundance would also be beneficial in that control measures practised by individuals could be made more efficient, new pests could be more easily detected, prediction of insect outbreaks could be tested and greater assistance could be given in developing long-range agricultural programmes.

CARTER (Walter). **The geographical Distribution of Mealybug Wilt with Notes on some other Insect Pests of Pineapple.**—*J. econ. Ent.* **35** no. 1 pp. 10–15, 7 figs., 10 refs. Menasha, Wis., 1942.

In the course of a survey in 1937–38 for natural enemies of *Pseudococcus brevipes*, Ckll., information was obtained on the geographical distribution of the mealybug wilt that it causes in pineapple. The distribution of the wilt is reviewed from the literature, including unpublished references to its occurrence in Florida, the Loochoo Islands, the Bonin Islands and some of the Japanese Mandated Islands. It was found by the author in South Africa, Kenya Colony, Malaya, the Philippines, Australia and Fiji, but not in Java, though the mealybug was present there. The incidence of the wilt was low on virgin lands rich in organic matter and in areas of high rainfall without extreme temperatures. The mealybug was found wherever pineapple was growing and caused green spotting [*cf. R.A.E.*, A **21** 64] in many localities ; these green-spotting strains, however, appeared to have different symbionts from those of

the corresponding strain in Hawaii, and it no longer appears likely that the rod-shaped symbiont, typical of the latter, is the cause of this symptom [*cf.* **23** 166]. The possibility that different biological strains of *P. brevipes* have developed is discussed [*cf.* **26** 570 etc.]. There was no evidence of effective biological control of *P. brevipes*, with the possible exception of a single case of fungous infection in Queensland.

A list is given of other mealybugs found on pineapple, of which only *P. adonidum*, L., which produced well-defined chlorotic spots on pineapple leaves in Queensland, appeared to affect the plant. Occasional infestations by a Diaspine scale were found in Africa and in Fiji, where it produced large chlorotic spots on the leaves, and *Oryctes monoceros*, Ol., and *Anomocaulus fulvovestitus*, Fairm., were observed causing serious though localised damage in the heart tissues of young plants in Portuguese East Africa and Fiji, respectively.

KNOWLTON (G. F.). **Predators of** *Trioza maura*.—*J. econ. Ent.* **35** no. 1 p. 15. Menasha, Wis., 1942.

A list is given of predacious insects found in association with the willow Psyllid, *Trioza maura*, Först., which occurred in large numbers on willows in Weber County, Utah, in August 1941; they included *Geocoris atricolor*, Montd., *Chrysopa oculata*, Say, and *Coccinella transversoguttata quinquenotata*, Kby., which were observed to feed on the Psyllid.

YUILL (J. S.). **Preliminary Studies on the Control of the Lodgepole Needle Miner.** —*J. econ. Ent.* **35** no. 1 pp. 16–20, 1 fig., 3 refs. Menasha, Wis., 1942.

In the Sierra Nevada of California, the larvae of *Recurvaria milleri*, Busck, destroy the needles of lodgepole pine (*Pinus contorta*), particularly in mature and overmature trees, by mining the inner tissue, and severe localised outbreaks, which persist for 10–15 years, usually result, directly or indirectly, in the death of 80–90 per cent. of the mature trees. Since the forest cover essential in recreation areas in the Sierras is often formed of mature stands of this pine, methods of preventing attack in these areas were investigated in 1937 and 1938. During its two-year life-cycle [*cf. R.A.E.*, A **9** 391], *R. milleri* is protected in the needles except during the period in the late summer of the flight year when the eggs have been laid but the larvae have not yet entered the needles, during the migrations of the half-grown larvae in the autumn of the non-flight year or of older larvae in the following spring, and during flight. The first of these is the most favourable time to apply control measures, and in extremely heavy infestations, supplementary treatments might be useful during the second. Of a number of sprays applied to lightly infested trees about 18 days after the beginning of oviposition in 1937, one of 4 lb. lead arsenate, 1 U.S. pint nicotine sulphate, 2 U.S. quarts kerosene and $\frac{1}{2}$ lb. commercial W.S.C. dynamite spreader [*cf.* **25** 652] and another of 4 U.S. gals. light medium oil (92 per cent. unsulphonatable residue), 1 U.S. pint nicotine sulphate and 4 oz. blood albumin, both per 100 U.S. gals. spray, gave the best control (0 and 0·1 living larva per 1,000 needles, respectively). The effect of other combinations of oil and blood albumin varied considerably with the different supplementary insecticides used. Mist sprays gave inconclusive results, owing to air movement, and the organic poisons tested alone, phenothiazine [thiodiphenylamine] and tetramethylthiuram disulphide, were unsatisfactory. Lead arsenate caused no foliage injury, but oils at insecticidal concentration, even when highly refined, were rather harmful, and some of the organic compounds were so injurious as to be useless.

EATON (C. B.). **Biology of the Weevil *Cylindrocopturus eatoni* Buchanan, injurious to Ponderosa and Jeffrey Pine Reproduction.**—*J. econ. Ent.* **35** no. 1 pp. 20–25, 2 figs., 5 refs. Menasha, Wis., 1942.

The results are given of biological studies and control tests on *Cylindrocopturus eatoni*, Buchanan [*cf. R.A.E.*, A **29** 371], which occurs in central and north-eastern California, where it has recently been found to be injurious to forest plantings of pines (*Pinus ponderosa* and *P. jeffreyi*), its only known natural food-plants, usually when they are 1–3 ft. high. Injury is caused chiefly by the mining of the larvae within the cortical region, which usually results in the death of the tree by the time the larvae mature. Minor damage is caused by the feeding of the adults on the needles. The life-cycle lasts one year ; the winter is passed in the larval stage, pupation occurs in spring and the adult weevils emerge in June. The females oviposit in the stems and twigs of small trees early in July. *Rhopalicus pulchripennis*, Crwf., and *Eurytoma tomici*, Ashm., were bred from the larvae ; and *Urosigalphus pini*, Cushm., *Microbracon pini*, Mues., *Euderus subopacus*, Gah., *Ephialtes* (*Calliephialtes*) *comstocki*, Cress., and three Hymenopterous parasites not specifically identified were reared in cages containing infested material. *R. pulchripennis* was the most abundant, and it is probable that under natural forest conditions, parasites largely control the weevil. The larvae of *Enoclerus moestus*, Klug, were found preying on the larvae, but this Clerid is probably too rare in the field to give significant control. A common timber stain, caused by *Hormiscium gelatinosum*, is almost invariably associated with this weevil, and the fungus was cultured from various parts of infested trees as well as from different stages of the insect. Tests indicated that this fungus is not pathogenic by itself, but follows weevil attacks.

Control measures are probably uneconomic under natural forest conditions, but the protection of plantations is desirable. The eradication of infested trees in the plantation was ineffective, presumably owing to the emergence of large populations from naturally infested trees in the surrounding forest, but treating uninjured ponderosa pines with sprays containing acid lead arsenate, light oil, wetting agents and water (100 : 25 : 3 : 1,000) or synthetic cryolite, wetting agent and water (100 : 1 : 200) applied at the rate of 1 U.S. pint per 10 trees early in June in order to prevent feeding and oviposition gave complete protection without damage to the trees in cage and field tests in 1939. The lead-arsenate mixture is recommended because of its better weathering and covering properties.

CAMPBELL (R. E.). **Dichloroethyl Ether for protecting Melon Plants from Wireworms.**—*J. econ. Ent.* **35** no. 1 pp. 26–30, 1 ref. Menasha, Wis., 1942.

Since β-β-dichloroethyl ether, in addition to being toxic to wireworms [*cf. R.A.E.*, A **25** 436], has a deterrent effect that persists for several weeks, preliminary experiments were made in California in 1939–40, in which it was applied to the seeds of melon and the soil round them at the time of sowing, in order to prevent attack rather than to kill wireworms already present. Tests were made on ground infested by *Pheletes* (*Limonius*) *canus*, Lec., and *P.* (*L.*) *californicus*, Mannh. When applied either to the seeds or in the soil at strengths of 10 and 33 per cent. in a dust carrier, dichloroethyl ether repelled the wireworms, but damaged the sprouting seeds and young plants. It is difficult to dissolve in water, but was rendered more soluble by the addition of 1·4 oz. per U.S. gal. of a material described as sodium salt of alkyl ester of sulphosuccinic acid. When solutions at concentrations of 7–30 fl. oz. per 100 U.S. gals. were applied at the rate of 1 U.S. quart per hill to the soil at the time of sowing, they protected the sprouting seeds and young plants for three weeks, and a further application at the end of this time gave protection for another four weeks. Solutions of 27–30 fl. oz. per 100 U.S. gals., applied at the rate of 1 or 2 U.S.

quarts per hill, injured some of the germinating seeds, the degree of injury varying with the amount applied and the type of soil. The dichloroethyl ether acted primarily as a repellent to the wireworms, but also killed those that were in the treated part of the soil at the time of application.

BLANTON (F. S.). **Methyl Bromide for the Control of the Serpentine Leaf Miner in Gerberas and Notes on the Insect's Life History.**—*J. econ. Ent.* **35** no. 1 pp. 31–34, 2 refs. Menasha, Wis., 1942.

The following is based on the author's summary of this account of investigations on *Agromyza pusilla*, Mg., which has caused serious damage to almost all varieties of *Gerbera jamesoni* grown in greenhouses near Babylon, New York, resulting in some instances in a loss of 50 per cent. of the flower harvest. The eggs are laid in the upper surface of the leaf and hatch in 5–10 days. The larvae feed for 6–10 days, and there are sometimes as many as 250 in a single leaf. Natural pupation occurs in the soil, but a few individuals pupate on the surface of the leaves. The pupal period under summer greenhouse conditions is 11–15 days. The complete life-cycle has been as short as 27 days.

In fumigation tests with methyl bromide at a temperature of 70°F. or slightly more in May–July, when the greenhouse plants are divided and transplanted, all larvae were killed at dosages of 32 oz. per 1,000 cu. ft. for 2·5 hours and 12 oz. for 4 hours, while over 99 per cent. were killed at 4 and 5 oz. for 12 hours; the only survival at the 5-oz. dosage occurred when the fan in the fumigation chamber did not operate. Complete mortality of the eggs was obtained at dosages of 32 oz. per 1,000 cu. ft. for 2·75 hours, 12, 16 and 20 oz. for 4 hours and 5 oz. for 12 hours. It appears that gerberas will tolerate a dosage up to 16 oz. per 1,000 cu. ft. for 4 hours, but will suffer some foliage injury and also slight root injury to the more susceptible varieties, and this dosage should result in practically complete control of all stages of the leaf-miner.

FAY (R. W.). **Distribution of Arsenic in the Body of the American Roach.**—*J. econ. Ent.* **35** no. 1 pp. 45–47, 5 refs. Menasha, Wis., 1942.

Since the effectiveness of a stomach poison depends on the amount absorbed from the gut, a quantitative study was made of the passage of sodium meta-arsenite through the gut of *Periplaneta americana*, L., and its absorption from the gut and distribution in the blood, head, thorax and abdomen. The technique is described, and details of the results are given. They showed that approximately 11 per cent. of the arsenic ingested was actually absorbed from the gut to effect the kill. A comparison between this study and studies on other arsenical salts or between different concentrations of sodium meta-arsenite should reveal factors that influence arsenic absorption and toxicity and aid in the development of more efficient arsenical insecticides.

MUNGER (F.). **Reactions of the *Citrus* Thrips to Sugar in poisoned Baits.**—*J. econ. Ent.* **35** no. 1 pp. 51–53, 1 fig., 4 refs. Menasha, Wis., 1942.

The results of laboratory tests to determine the function of sugar in the bait-sprays of tartar emetic used against *Scirtothrips citri*, Moult., on *Citrus* [*cf. R.A.E.*, A **27** 425; **29** 296] indicated that the thrips is attracted to sugar (sucrose) as an article of diet, since all active stages of the insect fed voraciously on granulated sugar, even in the presence of tender lemon foliage, and mass rearing was more efficiently accomplished if the leaves in the rearing cages were dusted with sugar. Sprays in which the poison was tartar emetic or barium antimonyl tartrate and in which sugar represented 0–99 per cent. of the weight of dry material were applied to lemon leaves and compared against adult females, and it was found that tartar emetic was significantly the more toxic

poison, the differences being slight at sugar contents of 0, 1 and 99 per cent. and considerable at 25–75 per cent. After exposure for 48 hours, mixtures containing 50 and 75 per cent. sugar gave higher mortality than those containing only 25 per cent. In further tests with tartar-emetic sprays to find the optimum percentage of sugar, 60–90 per cent. gave significantly higher mortalities than 40 or 50 per cent. after 24 hours, and 80 or 90 per cent. and 60–90 per cent. than 50 and 40 per cent., respectively, after 48 hours. In two preconditioning tests, adult females kept for 18, 42 and 66 hours on sugared lemon leaves showed no significant difference in susceptibility to the bait, but those deprived of sugar for 42 and 66 hours were much more susceptible than those deprived for only 18 hours.

LITTLE (V. A.). **Rotenone Content, an inherited Character in the Roots of Devil's Shoestring,** *Tephrosia virginiana*.—*J. econ. Ent.* **35** no. 1 pp. 54–57, 4 refs. Menasha, Wis., 1942.

The author describes investigations on *Tephrosia virginiana* as a possible source of rotenone and related compounds, carried out in Texas in 1936–40, in which the inheritance of these compounds and the influence of soil and climate on them were studied. It was found that plants that are highly toxic, on the basis of rotenone determinations and the modified Durham colour test, retain their toxicity when transferred to a district yielding only mediocre material and also that they remain toxic when transferred from one soil type to another. It was also shown that highly toxic plants when isolated tend to produce offspring of similar toxicity [*cf. R.A.E.*, A **29** 398]. On the basis of these results, with the amount of variation in the rotenone content shown, it is believed that by following approved scientific methods of plant breeding and propagation, highly toxic strains of *T. virginiana* can be developed.

PLETSCH (D. J.). **The Effect of some Insecticides on the immature Stages of the Potato and Tomato Psyllid,** *Paratrioza cockerelli* **(Sulc).**—*J. econ. Ent.* **35** no. 1 pp. 58–60, 1 graph, 1 ref. Menasha, Wis., 1942.

The results are given of tests on the susceptibility to insecticides of the several nymphal instars of *Paratrioza cockerelli*, Šulc, carried out in August 1939 on heavily infested tomatos in Montana. The sprays tested were 1 gal. liquid lime-sulphur (28°Bé.) in 35 gals. water, 1 lb. dry lime-sulphur containing 70 per cent. calcium polysulphide or 1 lb. wettable sulphur in 10 U.S. gals. water, and 4 oz. nicotine sulphate with 20 oz. summer oil emulsion in 8 U.S. gals. water, and the dusts were dusting sulphur, a mixture of hydrated lime, dusting sulphur, household lye and nicotine sulphate (10 : 80 : 1 : 1) and one of pyrethrum dust (10 per cent. Dry Pyrocide), dusting sulphur and diatomaceous earth (2 : 11 : 7). The insecticides were applied to individual leaves in the laboratory or to the growing plants, and the mortality of each instar was determined on the following day. None of the treatments caused outstanding collapse or shrivelling of the eggs. Nymphs in the first instar showed little resistance to any of the insecticides used, mortality of those in the second instar remained uniformly high except on foliage treated with the spray of oil and nicotine, and that in the third instar showed little change, remaining above 80 per cent. for all but the oil-nicotine treatment. Fourth-instar nymphs showed increasing resistance to the oil-nicotine and the wettable sulphur spray, the remainder of the treatments giving more than 80 per cent. kill, but there was a great range in mortalities from the various treatments in the fifth instar. The most effective material against this instar was the dust containing nicotine sulphate and sulphur, which, however, had to be used soon after mixing for maximum effectiveness and tended to clog the duster ; the liquid lime-sulphur

spray, which is already recommended against the Psyllid as a standard measure of control, gave between 60 and 80 per cent. mortality, sulphur dust alone between 40 and 60 per cent., and the other treatments less than 40 per cent.

It is concluded that insecticides will be most effective if applied when the younger nymphal instars predominate.

MORRILL jr. (A. W.). **Insect Damage to Tobacco in the Connecticut River Valley.**—*J. econ. Ent.* **35** no. 1 pp. 60–62. Menasha, Wis., 1942.

A summary is given of the methods and results of surveys of insect damage to tobacco in the Connecticut River Valley, carried out each year between 1936 and 1940. Observations were made principally just before harvest on mature tobacco, chiefly Havana seed tobacco, but also in the seed bed and on the newly set plants. *Epitrix cucumeris*, Harr., damaged the largest proportion of leaves on mature tobacco [*cf. R.A.E.*, A **30** 130], followed in descending order by *Frankliniella fusca*, Hinds, grasshoppers, largely *Dissosteira carolina*, L., and *Melanoplus femur-rubrum*, DeG., and the Sphingids, *Protoparce quinquemaculata*, Haw., and *P. sexta*, Joh. Injury by thrips and grasshoppers was most severe on the edges of fields adjoining grassland. Damage by the cutworms, *Amathes* (*Graphiphora*) *c-nigrum*, L., *Euxoa messoria*, Harr., and *Polia legitima*, Grote, was severe wherever poisoned baits were not used; that by *Lygus oblineatus*, Say, though serious in a few fields, was of little importance over the whole area. Replanting was frequently necessitated by injury due to *Pheletes ectypus*, Say (*Limonius agonus*, Say) in comparatively restricted areas, and occasionally by *Hylemyia cilicrura*, Rond., *Tipula georgiana*, Alex., *Nephrotoma ferruginea*, F., and *N. sodalis*, Lw., none of which, however, was widespread in any year.

Less important pests that attacked tobacco at various stages included *Trifidaphis phaseoli*, Pass., *Macrosiphum solanifolii*, Ashm., *Bourletiella hortensis*, Fitch, *Epitrix parvula*, F., *Euschistus variolarius*, P. de B., *Papaipema nebris*, Gn. (*nitela*, Gn.), *Heliothis virescens*, F., and *Crambus caliginosellus*, Clem. Slight damage in 1939 and 1940 was caused by *Popillia japonica*, Newm. [**30** 40, 223].

Shade, broad-leaf and Havana seed tobacco were attacked by the same insects about equally, though shade tobacco was usually less severely damaged by *Protoparce* and grasshoppers, probably owing to the protection afforded by the shade tents.

RONEY (J. N.). **Vegetable Weevils spread by Motor Vehicles.**—*J. econ. Ent.* **35** no. 1 p. 62. Menasha, Wis., 1942.

Listroderes obliquus, Gylh., has become widely distributed in Texas since its introduction from Louisiana in 1931, when it was found in four counties in the south-east. In 1932 it was taken in the north-east of the State, and in 1936 it was found in three counties further west, 75–100 miles from each other and 150–300 miles from any area previously known to be infested. There were large, apparently uninfested, areas between these points and the main infested area. On 5th and 7th May 1941, adults were attracted to the head-lamps of a car that was parked about a quarter of a mile from an infested field, and it is considered that the weevils may be attracted to the headlamps of cars travelling across country, become lodged in the chassis and be transported many miles. This view is supported by the fact that the westward dispersal has been along important thoroughfares. *L. obliquus* was also taken in numbers on the porches of houses, where it was probably attracted to electric lights.

Siegler (E. H.), Gertler (S. I.) & Haller (H. L.). **Toxicity of some Semicarbazones to Codling Moth Larvae.**—*J. econ. Ent.* **35** no. 1 pp. 74–76, 4 refs. Menasha, Wis., 1942.

The following is substantially the authors' summary. Ketone and aldehyde semicarbazones are readily prepared from semicarbazide hydrochloride. Out of 30 derivatives tested against the newly hatched larvae of the codling moth [*Cydia pomonella*, L.], the following semicarbazones indicated some promise for insecticidal use: *p*-chloroacetophenone, 2-heptanone, cyclopentanone, 2-octanone and 2-furaldehyde. In small-scale spray tests of these compounds (except 2-heptanone, which was not tried) on apple and peach foliage, no injury resulted except to a very slight extent with *p*-chloroacetophenone alone and combined with Bordeaux mixture on one variety of apple.

Farrar (M. D.). **Small Insect Cage.**—*J. econ. Ent.* **35** no. 1 p. 76, 4 figs. Menasha, Wis., 1942.

The author describes the construction from a 1½ oz. gelatin veterinary capsule of a cage that can contain about 200 live grain insects of a known culture and about 1 oz. grain and be inserted by means of a grain probe within a bin of grain for fumigation tests.

Kinsley (C. H.). *Reticulitermes tibialis* **in Cottonseed Hulls.**—*J. econ. Ent.* **35** no. 1 p. 76. Menasha, Wis., 1942.

Cottonseed hulls have often been used of recent years in grasshopper baits in California, and in 1941 over 200 sacks containing them were stacked for the summer in the open, only 171 feet above sea level, on bare ground that was slightly damp at the time of stacking. At the end of the summer the bottom layer was found to be infested by *Reticulitermes tibialis*, Banks, which is widely distributed in the Western United States and is said to occur frequently at high elevations. Termites had not previously been observed in this locality in cottonseed hulls.

Simmons (P.), Barnes (D. F.), Fisher (C. K.) & Kaloostian (G. H.). **Caddisfly Larvae fouling a Water Tunnel.**—*J. econ. Ent.* **35** no. 1 pp. 77–79, 2 figs., 3 refs. Menasha, Wis., 1942.

An account is given of observations on an extensive infestation of caddisfly larvae in the uppermost of a series of tunnels that take part of the water from a river in the Sierra Nevada mountains after it has passed through fish screens and a flume from a settling basin. The accumulated matting of larval shelters and nets on the concrete lining of the walls and floor reduces the rate of flow of the water so that it is necessary to shut off the water and remove the matting at intervals; this is generally done when the flow is reduced by about 50 cu. ft. per second (approximately 8 per cent.). Several species of Trichoptera, among which *Hydropsyche occidentalis*, Banks, and *Dolophilus gabriella*, Banks, predominated, emerged from caged matting or were taken at light. The overwintered infestation had no effect on the efficiency of the tunnel until after 15th May, and reinfestation began to influence the flow about three weeks after cleaning; the low water levels in autumn and early winter appeared to control the height to which the matting reached in the following May and June (about 30 ins.), when the depth of water was about 9 ft.

Cleaning the tunnel with a high-pressure stream of water gave good results, and a heavy application of waterproof grease completely prevented the attachment of the larvae for 13 months, and much of the grease was still intact after 25 months, though the coating had, in general, deteriorated.

In addition to the heavy infestation in the upper tunnel, some infestation was reported from further down, partly in open conduits. The authors were informed that the flow in two covered sections of an aqueduct of the Los Angeles water-supply system was materially reduced by such infestations; drying the conduits to kill the insects, followed by scraping, gave temporary relief, and covering open approaches to the tunnels is said to have eradicated the infestations.

CHIU (Shin Foon), LIN (Sping) & CHUI (Yee Som). **Insecticidal Action of *Millettia pachycarpa* Benth.**—*J. econ. Ent.* **35** no. 1 pp. 80–82, 5 refs. Menasha, Wis., 1942.

The authors summarise the results obtained in laboratory experiments begun in China in 1940 on the insecticidal action of seeds of *Millettia pachycarpa*, the active constituents in which are rotenone and the rotenoid group of compounds. The seeds were ground to a fine powder and extracted with water, alcohol or acetone. When extracts prepared by soaking 10 gm. powder in 100 cc. solvent for 5 days and 1 day were applied as a fine spray to adults of *Musca domestica*, L., and full-grown larvae of *Pieris rapae*, L., respectively, the material was the most effective against *M. domestica* when extracted in acetone and against *P. rapae* in alcohol; all the extracts showed a high toxicity. Aqueous extracts prepared by soaking 0·25–3 gm. powder in 50 cc. distilled water for 24 hours were effective against full-grown larvae of *Acraea issoria*, Hb. (*Pareba vesta*, F.); the percentage mortality after 96 hours increased as the total solids per unit volume of spray increased to about 1·7 per cent., and there was no significant difference in average percentage mortality from concentrations of 1·72, 1·92 and 1·7 per cent. Fourth-instar larvae of *Bombyx mori*, L., that were allowed to feed freely on sandwiches of mulberry leaves and powdered *Millettia* seeds died 1–72 hours after absorbing sufficient of the poison; the median lethal dose for 178 insects was 0·027 mg. per gm. body weight.

MUESEBECK (C. F. W.). **Common Names of Insects approved by the American Association of Economic Entomologists.**—*J. econ. Ent.* **35** no. 1 pp. 83–101. Menasha, Wis., 1942.

These lists, in which the popular and scientific names of the insects are arranged in alphabetical order, contain the names previously approved by the Association with changes and additions made during 1940, and supersede all earlier lists and supplements [*cf. R.A.E.*, A **29** 280, etc.].

WORTHLEY (H. N.) & STEINER (H. M.). **Injury from Peachtree Borer Treatments.**—*J. econ. Ent.* **35** no. 1 pp. 102–103, 1 fig., 2 refs. Menasha, Wis., 1942.

Although experimental treatment with ethylene dichloride emulsion against *Aegeria* (*Sanninoidea*) *exitiosa*, Say [*cf. R.A.E.*, A **28** 356] caused no injury to peach trees in Pennsylvania in 1938 and 1939, similar treatments applied during the autumn of 1940 caused some damage. In these tests, each tree was treated once between 20th September and 19th November with ½ oz. paradichlorobenzene, applied as crystals by the ring method or in an emulsion, with 1 U.S. pint Parascalecide (1 : 7) or with ½ U.S. pint 20 per cent. ethylene dichloride emulsion. The paradichlorobenzene emulsion was prepared by dissolving 3 lb. paradichlorobenzene in 6 U.S. quarts warm cottonseed oil and pouring the oil into 18 U.S. quarts water containing 3 fl. oz. fish-oil soap. The liquids were poured directly on the soil, not touching the tree, but in most cases

spread to the bark. Infestation was light and variable, but the crystal paradichlorobenzene appeared to be more effective in the early applications than in the late ones, whereas the reverse was true of ethylene dichloride; fewer surviving borers were found in trees treated with the liquids than in those treated with the crystals. The crystals caused no injury to the trees, and Parascalecide damaged only a few, but the other two liquid treatments showed some injury in all applications and severe injury in some. No signs of "winter injury" were found on untreated trees. There appears to be a relation between soil condition and injury, since ethylene dichloride caused negligible injury in early treatments on dry, warm soil, but severe injury when applied in November to very wet, cold soil; the paradichlorobenzene emulsion produced most damage in early treatments. It is recommended that liquid treatments for peach borer control should be employed with caution until their safety in the localities in which they are to be used has been proved by careful tests.

Geissler (G. H.), Gould (E.) & Hamstead (E. O.). **The Occurrence of Comstock Mealybug on Roots of Orchard Vegetation.**—*J. econ. Ent.* **35** no. 1 p. 103. Menasha, Wis., 1942.

In 1941, *Pseudococcus comstocki*, Kuw., which is a relatively recent apple pest in the Cumberland-Shenandoah fruit belt [*cf. R.A.E.*, A **30** 128], was less prominent in orchards in West Virginia than in previous years and caused little damage to the fruit. During the season, numerous mealybugs, often accompanied by ants, were found below ground level on the roots of plants in orchards, only one of which showed a general infestation on the fruit trees. *P. comstocki* was collected on roots of smartweed (*Polygonum*) and evening primrose (*Oenothera*); in the latter case it was attended by *Crematogaster lineolata*, Say, and eggs were present. *P. maritimus*, Ehrh., with eggs, was found on the roots of an apple seedling, and a species allied to it on golden-rod (*Solidago*). Another species of *Pseudococcus* with eggs, found on *Sassafras albidum*, was attended by *Lasius* (*Acanthomyops*) *claviger*, Roger. Single individuals from roots of wild cherry and wild carrot were not identified; evidence that mealybugs had been present on plants of several other species was observed.

Sweetman (H. L.) & Smith (M. E.). *Scymnus creperus* **Muls., a Predator on the Woolly Elm Aphid.**—*J. econ. Ent.* **35** no. 1 pp. 103–104. Menasha, Wis., 1942.

Eriosoma americanum, Riley, was very abundant on American elm [*Ulmus americana*] at Amherst, Massachusetts, in late May and early June 1941, when *Scymnus creperus*, Muls., destroyed large numbers of this Aphid in the curled leaves. On warm days in the middle of June, the Coccinellid larvae migrated from the curled leaves and swarmed over the trunks and about the bases of the trees, apparently seeking shelter in rubbish under the trees, where many of them pupated; none was seen on the trunks of trees that had been sprayed early in June with a mixture of nicotine and an arsenical. The unusual abundance of the predator, which probably resulted in great destruction of the Aphids, may have been due to the extreme dryness of the previous autumn and spring and the earliness of the season. Records of the Massachusetts Agricultural Experiment Station indicated that the related Coccinellid, *Stethorus punctum*, Lec., was very common in apple orchards, where it attacked *Aphis pomi*, DeG., and red mites.

Bissell (T. L.). **A micro Leaf Worm on Peanuts.**—*J. econ. Ent.* **35** no. 1 p. 104, 2 figs., 3 refs. Menasha, Wis., 1942.

The author records a light infestation of ground-nuts in a locality in Georgia by larvae of *Stegasta bosquella*, Chamb., which tunnel the ends of the shoots and

feed on the unfolding leaves, but have not caused appreciable damage there. The larvae were also collected on *Chamaecrista* in the same and another locality in the State. Pupation took place in the tunnelled shoots. Larvae collected on ground-nut in October 1935 and September 1941 and on *Chamaecrista* in August 1941 transformed to adults in December 1935 and October and September 1941, respectively.

KNOWLTON (G. F.). **Nitidulidae in Corn.**—*J. econ. Ent.* **35** no. 1 p. 105, 1 fig. Menasha, Wis., 1942.

Nearly all the ears of sweet maize examined in a locality in southern Utah on 28th July 1938 contained at least three corn earworms [*Heliothis armigera*, Hb.] and also 1–7 adults and 2–13 larvae of *Carpophilus* (*Urophorus*) *humeralis*, F., which was observed in all ears containing *H. armigera*. The larvae of the Nitidulid often occurred in shallow excavations between rows of kernels, suggesting that they are not merely scavengers, and limited feeding on uninjured kernels appeared to be taking place. A heavy infestation of *C. lugubris*, Murr., in central Utah in August 1939 was most severe in sweet maize, though numerous larvae and adults were present in field maize ; both stages were particularly abundant where larvae of *H. armigera* had previously fed. At the same time, *Glischrochilus quadrisignatus*, Say, was moderately abundant inside ears of sweet and field maize. The last two species were also taken in northern Utah in September.

ROARK (R. C.). **Definition of Aerosol.**—*J. econ. Ent.* **35** no. 1 pp. 105–106, 7 refs. Menasha, Wis., 1942.

Recently described methods of dispersing non-volatile insecticides in the air or of enhancing the efficacy of fumigants of low volatility [*cf. R.A.E.*, A **29** 127, 555 ; **30** 272, 368] involve dispersing a liquid or solid in the air in colloidal form, thus creating a mist or a smoke, and these suspensions in air have been known for nearly 20 years as aerosols. It is pointed out that in 1940 the United States Patent Office granted a trade-mark covering the use of the word Aerosol for a proprietary wetting agent, but there should be no confusion regarding the two uses of the word.

CHANDLER (S. C.). **Plum Curculio on Peach following a total Crop Failure.**—*J. econ. Ent.* **35** no. 1 pp. 106–107, 2 graphs, 2 refs. Menasha, Wis., 1942.

Owing to the almost complete absence of peaches in the season of 1940, caused by a severe winter, the percentage of infestation by *Conotrachelus nenuphar*, Hbst., at harvest time in 25–30 commercial orchards in the principal peach areas of Illinois fell from 3·8 in 1939 to 0·72 in 1941. The total number of beetles jarred at weekly intervals from 10 trees in the outer rows of an orchard and 10 in the fifth row was reduced from 246 in 1939 to 62 in 1941, when only about 2·4 times as many were jarred from the first two rows as from the fifth row [*cf. R.A.E.*, A **29** 197]. In both seasons, very few weevils appeared in the orchards before sepal fall.

KNOWLTON (G. F.) & THORNLEY (H. F.). **Insect Food of the Sage Grouse.**—*J. econ. Ent.* **35** no. 1 pp. 107–108. Menasha, Wis., 1942.

Lists are given of insects identified in the stomach and crop contents of 17 examples of *Centrocercus urophasianus* collected in Utah. Eggs of the Mormon cricket [*Anabrus simplex*, Hald.] were found in five of them and one nymph and one adult were present. Although in one instance 85 per cent. by volume of the contents was insect material, in most cases approximately 75–92 per cent. was of plant origin.

Flanders (S. E.). **Sex Differentiation in the Polyembryonic Proclivity of the Hymenoptera.**—*J. econ. Ent.* **35** no. 1 p. 108, 6 refs. Menasha, Wis., 1942.

Polyembryonic development in parasitic Hymenoptera is dependent on the utilisation of nutritive materials from the host in addition to that stored in the egg. The transfer of such material is accomplished by means of a cellular trophic membrane originating within the egg and enclosing the embryos. This membrane is also present in a number of monoembryonic species. Certain parasitic Hymenoptera consume protein materials only during larval development. Apparently it is only in such species that specialised monoembryonic and polyembryonic development takes place. The tendency of the female towards specialised embryonic development in which the embryo is nourished by the host is exemplified in the monoembryonic Aphelinid, *Coccophagus capensis*, Comp., a parasite of *Saissetia oleae*, Bern., that was introduced into California from South Africa [*cf. R.A.E.*, A **29** 386]. In this species, the trophic membrane is produced only in the fertilised (female) egg. The haploid (male) embryo completes its development without the aid of such a membrane. Evidence from a brief survey of the literature indicates that in polyembryonic species, the unfertilised (male) eggs tend to develop monoembryonically. In *Platygaster hiemalis*, Forbes, in which polyembryony is limited to twinning [*cf.* **12** 15], the dominance of one sex is attributed to the monoembryonic development of the other. In this species, occasional male predominance probably is not an effect of polyembryony but of the deposition of several unfertilised eggs. In species in which both sexes develop polyembryonically, the number of adults in pure male broods averages less than in pure female broods. In the great majority of mixed broods from individual hosts, the females greatly outnumber the males. The tendency of the fertilised (female) egg towards polyembryony may be obscured if superparasitism occurs, as in *Macrocentrus gifuensis*, Ashm. In such a case, the competition for food during the larval period may result in the selective elimination of the female. It has been shown that the sex ratio in mixed broods is greater in its proportion of females than the probable sex ratio of the eggs from which the brood was derived.

Knowlton (G. F.) & Meier (W.). *Collops bipunctatus* **Say.**—*J. econ. Ent.* **35** no. 1 p. 108, 1 fig. Menasha, Wis., 1942.

The Malachiid, *Collops bipunctatus*, Say, is commonly found in lucerne and clover fields throughout Utah and is sometimes moderately abundant on peas grown for canning. It was observed to feed on the pea Aphid, *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) in the field, and when caged with 10 Aphids each day for eight consecutive days on a small spray of lucerne, a single adult consumed a total of 43.

Wilbur (D. A.) & Fritz (R. F.). **An Epizootic among the Thistle Hoppers, *Aeoloplus turnbulli bruneri* Caud., in Kansas.**—*J. econ. Ent.* **35** no. 1 p. 109. Menasha, Wis., 1942.

The population of the thistle hopper, *Aeoloplus turnbulli bruneri*, Caud., on a representative area of 10 square miles in Finney County, Kansas, estimated to be over 31 million in 1939 and 65 million in 1940, when it comprised over two-thirds of the entire grasshopper population, was somewhat reduced in the spring of 1941, owing to unfavourable weather at hatching time, but still comprised over half of the total numbers in May ; in June and August 1941, however, the species had almost entirely disappeared from the area, owing to an outbreak of a disease, which was presumably caused by a virus or bacterium, since no fungous growth could be detected. Evidence of the epizootic was found in all of 18 counties surveyed in the extreme west of the State. Both adults and nymphs were affected.

Strickland (E. H.). **Variations in the Length of the Life-cycle of Wireworms.**—*J. econ. Ent.* **35** no. 1 pp. 109–110, 1 ref. Menasha, Wis., 1942.

The author records that in a series of investigations to ascertain the variations in the duration of the life-cycle of the northern grain wireworm, *Corymbites* (*Ludius*) *aeripennis destructor*, Brown, in Alberta [*cf. R.A.E.*, A **27** 539], two larvae that had been placed in field cages a few hours after hatching in 1932 had not pupated by the autumn of 1941 ; he points out that if they transform to adults by the autumn of 1942 and reproduce in 1943, the maximum life-cycle known in the field will be increased from 9 to 11 years. One of the wireworms had decreased in length since 1939, in spite of the fact that suitable food was available.

Woodside (A. M.). *Tenebroides corticalis* **Melsh. predaceous on Codling Moth Larvae.**—*J. econ. Ent.* **35** no. 1 p. 110, 3 refs. Menasha, Wis., 1942.

In 1940, many beetles identified as *Tenebroides corticalis*, Melsh., and a few larvae believed to belong to the same species, were found under burlap bands that had been placed round the trunks of six apple trees in an orchard in Virginia that was heavily infested with the codling moth [*Cydia pomonella*, L.], and both stages were observed to feed on the caterpillars both before and after they had spun their cocoons. In 1941, the beetles were again common under the bands, and only 66 larvae of *C. pomonella*, including about 40 that had been killed by the predator, were collected under them throughout the season. *T. corticalis* was less abundant on six banded trees in a more heavily infested orchard, but it is estimated that it destroyed 50 per cent. of the larvae that attempted to spin cocoons under the bands and almost all the larvae that entered the bands before mid-August. In the first orchard, fruit infestation decreased from 33 per cent. in 1940 to 12 per cent. in 1941, and in the second it decreased by about 50 per cent. in 1941, although infestation in most orchards in the county was 50–150 per cent. higher than in 1940.

Knowlton (G. F.) & Thornley (H. F.). *Gracilaria negundella* **Chambers, in Utah.**—*J. econ. Ent.* **35** no. 1 pp. 110–111. Menasha, Wis., 1942.

Whitening and curling of the leaves of box-elder trees [*Acer negundo*] observed in Utah on 1st September 1941 were found to be caused by *Gracillaria negundella*, Chamb. A species of *Habrocytus* near *thyridopterigis*, Ashm., which was apparently a hyperparasite, emerged in breeding cages. Adults of *Chrysopa plorabunda*, Fitch, were noticeably abundant on infested foliage, though the box-elder Aphid [*Periphyllus negundinis*, Thos.] and the box-elder Psyllid [*Psylla buxi*, L.] were relatively rare.

Breakey (E. P.). **Hosts of** *Merodon equestris* **Fabr.**—*J. econ. Ent.* **35** no. 1 pp. 111–112, 8 refs. Menasha, Wis., 1942.

The author reports that the larvae of *Merodon equestris*, F., destroyed or severely damaged bulbs of *Pancratium*, *Sprekelia*, *Cooperia*, *Chlidanthus*, *Hymenocallis* and *Zephyranthes*, in addition to varieties of *Narcissus*, in Washington State and discusses published records of other food-plants of the larvae.

Knowlton (G. F.). **Army Cutworm Outbreak in Utah.**—*J. econ. Ent.* **35** no. 1 p. 113. Menasha, Wis., 1942.

An extensive outbreak of *Chorizagrotis auxiliaris*, Grote, developed in Utah in the spring of 1941, when more than 30,000 acres of lucerne, wheat, other small grains, pastures and range land were moderately to heavily infested. The damage was serious in eight counties and less severe in seven more during late

March, April and early May. As in other recent outbreaks, the development of vegetation on many extensive crop and range areas was delayed, and young lucerne was entirely killed in several fields. The farmers usually irrigate infested lucerne fields to bring the larvae to the surface, and some employ brush-drags or harrows. Insectivorous birds commonly flocked into infested fields in 1941, and cutworms were found in the stomachs of several species.

McKenzie (H. L.). **A new Species of *Matsucoccus* attacking Piñon Pine in California (Homoptera ; Coccoidea ; Margarodidae).**—*Microentomology* **6** pt. 1 pp. 2–5, 2 figs. Stanford Univ., Calif., 1941.

The author describes the adult female and larval stages of both sexes of *Matsucoccus monophyllae*, sp. n., which attacks growing twigs of piñon pine (*Pinus monophylla*) in California, often occurring under the bracts or bark scales or in the angle between the twig and the needles. Preliminary observations indicated that the life-cycle lasts one year ; adult females emerge from the over-wintering intermediate-stage larvae [*cf. R.A.E.*, A **30** 517] during spring and migrate almost to the tips of the twigs to oviposit, the eggs being deposited in a waxy mass of threads. The killing of branches has been observed on trees heavily infested with this Coccid.

Bradley (W. G.). **Methods of breeding *Chelonus annulipes* on the Mediterranean Flour Moth for Use against the European Corn Borer.**—*Circ. U. S. Dep. Agric.* no. 616, 22 pp., 14 figs., 10 refs. Washington, D.C., 1941.

The following is substantially the author's summary. *Chelonus annulipes*, Wesm., is a Braconid parasite of the European corn borer (*Pyrausta nubilalis*, Hb.) native to northern Italy and first imported into the United States in 1929. The female deposits its egg in that of the host. The parasite larva passes through at least three instars within the host larva, issuing from it during the last instar and feeding externally until the remaining contents are devoured before spinning its cocoon.

After evidence had been obtained of the successful establishment of the parasite in Massachusetts, an attempt was made to breed it on *Ephestia kuehniella*, Zell., in order to provide adults for further distribution in the United States. Host eggs were obtained by confining the moths in cylindrical waxed cardboard food-cartons, of a capacity of ½ U.S. pint, provided with a screened bottom through which the host eggs were laid in fine-bolted white flour ; the adults laid only about half as many eggs when no flour was present. The absence of flour caused a slight delay in oviposition, but this delay, providing a longer mating period prior to oviposition, was not reflected in higher egg fertility. The moths were collected at random from the emergence cages ; there was no significant difference, either in quantity or in viability, between eggs laid by females thus collected and those collected in the act of mating. A maximum number of eggs was produced per carton when 500 moths were confined in each. After a carton had been used for four days, its contents were discarded and it was sterilised. Special care was given in all breeding operations to prevent invasion by mites or disease. The ovipositing moths were provided with fresh flour every 24 hours. The eggs were separated from the flour by brushing them over an 80-mesh screen in a funnel through which a controlled current of air was drawn by a modified vacuum cleaner, and were distributed through a metal pattern over a moistened card to form circular clusters of about 100 eggs each ; the eggs adhered to the card after it had dried. Mated parasite females were isolated during the entire oviposition period in 3- by 1-inch cork-stoppered shell vials. Food was supplied in the form of a drop of agar-sugar on a piece of paper pinned to the inner end of the cork. One cluster of host eggs was put near the bottom of each vial each day, and the vial was laid on its side with the bottom

towards the light until parasitisation was completed. When oviposition was not desired, the females were stored in a cool, dark place. Host larvae were reared in shallow cardboard boxes measuring 6 by 6 by 1 inches with a quarter-inch layer of whole-wheat flour (120 cc.) spread over the bottom to serve for food. Fifteen egg clusters were used in each box. The host larvae were reared in an incubator room at a temperature of 80°F. and relative humidity of not less than 70 per cent.; large numbers of growing larvae kept the humidity in the incubator room considerably above that outside. The life-cycle of *C. annulipes* averaged 44·85 days when it was reared on *E. kuehniella* under these conditions; the life-cycle of the host was about the same [*cf. R.A.E.*, A **27** 80].

Parasite adults were collected by being drawn by air currents into a celluloid cone attached to a modified hair drier. Moths to be used for oviposition were drawn directly into their oviposition cages; superfluous moths and débris were sucked into a killing can in the intake air line of a vacuum cleaner. The positive phototropic response of the parasite adults was made use of when collections were being made. Light caused the host moths to remain quiet. The parasites were mated in a large muslin-covered cage placed with its back towards a window and kept under observation. All females used for parasitisation were known to have mated. Unmated adults were confined between mating periods, with the sexes unsegregated, in a cool dark place.

In the generation reared for release in 1938, 24·5 adult parasites were produced per egg cluster. The average number of females ovipositing per day was 170·4, and an average of 17,040 host eggs was used each day. A total of 133,424 adult parasites were produced during the rearing period. The maximum number emerging on any day was 6,852. The average number of adults produced per parasite female used was 783. The most successful shipments of adult parasites were made in insulated boxes transported by railway express. In shipments requiring over 24 hours of travel, the boxes were re-iced in transit, with highly successful results.

YOTHERS (M. A.) & ALLAN jr. (P. B.). **Observations on the Biology and Control of the Treehopper *Heliria praealta* (Fowler) in Orchards of the Pacific Northwest.**—*Circ. U. S. Dep. Agric.* no. 606, 12 pp., 5 pls., 4 figs., 14 refs. Washington, D.C., 1941.

The Membracid dealt with in this paper has been recorded in recent economic literature as *Heliria rubidella*, Ball [*cf. R.A.E.*, A **17** 384; **22** 349], but W. E. China and P. W. Oman both consider that this form is not distinguishable from *H. praealta*, Fowler, and the authors now adopt their view. The following is based on the authors' summary. Observations on the biology and control of this treehopper were made near Wenatchee, Washington, during 1929–34 [*cf.* **22** 349]. It was found in some numbers in orchards in the Pacific Northwest in 1928 and 1929 and subsequently, but at present is considered to be of only minor importance. In the Wenatchee district, it oviposits and feeds on apple almost exclusively, rarely attacks cherry, pear and prune, and was found in single instances on poplar and wild choke cherry (*Prunus melanocarpa*). The eggs are deposited in the branches and twigs, and the entire life is spent on the tree. The nymphs hatch in late April or early May and mature about 1st June; the adults oviposit throughout July and August and occur in diminishing numbers during September. The adults frequently congregate in large numbers on the dying branches of apple trees, particularly of the Stayman Winesap variety affected with heart rot.

Sprays of lubricating oil emulsion (4 per cent.) applied during the dormant season appeared to give considerable control of the overwintering eggs in the bark. Summer oil emulsion (approximately 83 per cent. oil) at a concentration of 0·75 per cent. gave no control of the fourth and fifth instars, but might have some effect against the earlier ones; it is considered that sprays of nicotine or

nicotine and oil, such as are sometimes used against the codling moth [*Cydia pomonella*, L.] should prove effective against the younger nymphs, and adhesives, particularly if they are applied to dying branches, against the adults. Water sprouts in the centre of the trees should be pruned and destroyed before the eggs hatch in the spring.

Report of Progress for Year ending June 30, 1941.—*Bull. Maine agric. Exp. Sta.* no. 405 pp. 401–535, 7 figs.; many refs. Orono, Me., 1941.

This report contains notes by various authors on the insect pests of crops in Maine in 1940–41. *Lymantria* (*Porthetria*) *dispar*, L., again caused damage to apples in the summer of 1940 [*cf. R.A.E.*, A **30** 446], and experiments showed that where pink, calyx and first cover applications were made, spraying with lead arsenate at the rate of 3 lb. per 100 U.S. gals. water was more effective than dusting with lead arsenate and sulphur (1 : 9). The infestation was much lighter in the early summer of 1941, and the damage markedly less, owing to high mortality among the overwintering eggs ; of all those under observation in the spring of 1941, only about 1 per cent. hatched.

The adults of the apple race of *Rhagoletis pomonella*, Walsh, began to emerge on 1st July in 1940, about 5 days later than the average, and on 16th June in 1941, which was the earliest date observed for 11 years. Weekly records of the numbers of egg punctures per 100 apples on unsprayed trees during the summer of 1940 showed that they increased as the season advanced. The heaviest infestation and the earliest attack occurred on early sweet apples, while late apples were relatively unattractive Oviposition in the susceptible varieties was most intense between 20th July and 20th August. These observations indicated the importance of protecting the apples against drifting flies to the end of the period of active oviposition.

In further tests of dusts against the race of *R. pomonella* that attacks blueberries [*cf. loc. cit.*] the applications were made at intervals of about 8 days, beginning on 15th July, and all were at the rate of 6 lb. per acre. Two applications of calcium arsenate were more effective than three of commercial dusts containing 0·75 or 0·5 per cent. rotenone, but slightly less effective than three of a dust containing a proprietary sticker-spreader and 2 per cent. rotenone derived from ground derris root. The calcium-arsenate dusts were more injurious to the foliage, however, than those containing rotenone.

Four applications in May 1941 of a spray of 2 oz. tartar emetic and 8 oz. brown sugar in 3 U.S. gals. water failed to reduce injury to blueberry by *Frankliniella vaccinii*, Morg. In experiments with soil insecticides in the autumn of 1940 and spring of 1941, very satisfactory control of this thrips was given by a kerosene emulsion applied from a sprinkling can at the rate of 1 U.S. gal. per sq. yd. of soil surface, the emulsion used containing 1 U.S. pint kerosene and ½ oz. soap in 1 U.S. gal. water. The plants were not injured in the plots that were treated once only either in the autumn (25th October) after the thrips had entered hibernation or in spring (24th April) before they emerged from the soil, but injury followed when the emulsion was applied both in autumn and in spring.

The Mexican bean beetle [*Epilachna varivestis*, Muls.] continued to spread in 1940, and in many localities was responsible for considerable losses of beans. Experiments with dusts and sprays of calcium arsenate were continued [*cf. loc. cit.*] and cryolite dusts were also used ; a table is given showing to what extent they increased or reduced the yield of dried beans. The greatest yield was obtained with 1 part cryolite in 3 parts wheat flour, and the next best with a mixture of 1 part calcium arsenate, 15 parts wheat flour, 12 parts basic copper sulphate and 72 parts pyrophyllite. This indicates that basic copper sulphate can be used as a substitute for the ordinary copper sulphate, which appears to reduce the scorching of bean foliage often caused by calcium arsenate.

In experiments with derris dusts and dusts and sprays containing calcium arsenate against the striped cucumber beetle [*Diabrotica melanocephala*, F.] on cucumbers, the greatest yield was obtained from plants dusted with a mixture of calcium arsenate and magnesia talc (1 : 15), and this mixture is evidently one of the best diluents for the arsenate when applied to cucumbers. The second highest yield was obtained with a derris dust, but the addition of a spreader (sodium lauryl sulphate) to dusts containing either insecticide resulted in injury to the foliage and a relatively low total yield.

The infestation of canning peas by the pea Aphid [*Macrosiphum onobrychis*, Boy.] was comparatively light in 1940. In field experiments, the highest percentage mortality (70·7) was given by spraying with an acetone extract of derris, and derris dusts were more effective when used in combination with a wetting and spreading agent. One test suggested that terpene ether was of value as an activator in derris dusts containing a wetting agent. In the summer and autumn of 1940, the Aphids in many fields were attacked by disease [*cf.* **30** 447].

HOUSER (J. S.) & CUTRIGHT (C. R.). **The European Red Mite.**—*Proc. Ohio hort. Soc.* **74** pp. 26–34. Columbus, Ohio, 1941.

The authors discuss the control of *Paratetranychus pilosus*, C. & F., on apple and plum in Ohio by means of dormant and summer sprays. Experience with dormant sprays has shown that this mite is abundant early in the summer and scarce towards the end of the season on trees sprayed with lime-sulphur, whereas infestation is very light in early summer and severe in late summer on trees sprayed with oils. This was confirmed in experiments on apple in 1940. The difference is apparently due to the fact that the Coccinellid, *Stethorus punctum*, Lec., which is an important natural enemy of the mite, increases rapidly in early summer on trees sprayed with lime-sulphur, but not on those sprayed with oil. Its slow increase on the oil-sprayed trees is probably due to the initial scarcity of its host, and possibly also to its own overwintering population having been reduced by the oil.

Experiments with summer sprays in 1940 showed that *Paratetranychus* was not controlled by full schedules of lime-sulphur or flotation sulphur or schedules including both, but that there was a reduction in infestation when sulphur was omitted from all cover sprays or included in the first only. This reduction was due to the predacious mite, *Seius* sp., which is highly susceptible to sulphur. In tests on the effect of rotenone on *P. pilosus*, sprays containing a proprietary preparation and summer oil or a spreader, applied on 1st September 1940 to 13-years-old apple trees, were compared with a spray of summer oil, lime and zinc sulphate ; both gave very much better control. It is concluded that the best treatment against the mite is to apply a dormant oil if the overwintering eggs are numerous and a rotenone spray in summer if the oil has been omitted and the mite increases to dangerous numbers by midsummer.

MARSHALL (G. E.), CHILDERS (N. F.) & BRODY (H. W.). **Leafhoppers can weaken Apple Trees and reduce the Crop.**—*Proc. Ohio hort. Soc.* **74** pp. 61–66. Columbus, Ohio, 1941.

Observations on leafhoppers attacking apple in an orchard in southern Indiana carried out between September 1939 and October 1940 showed that nearly 75 and about 25 per cent. are *Typhlocyba pomaria*, McAtee, and *Erythroneura* sp., respectively ; *Empoasca fabae*, Harr., which migrates each year from the south and dies out during the winter, was present in very small numbers. *T. pomaria* overwinters in the egg stage beneath the cork cells in the bark, mostly of wood 2–4 years old. The nymphs hatched early in May, the resulting adults oviposited at about mid-June, and the summer-generation nymphs hatched within

a week. *Erythroneura* sp. hibernates in the adult stage in damp decaying leaves under apple trees or in thick grass along fence rows, and resumes activity at about the time that the buds show green in spring ; the females lay eggs in the mid-veins and petioles of the apple leaves about 1st May. Weekly estimates were made from 6th May to 11th October of the numbers of leafhoppers on a large tree. The population fluctuated very considerably from week to week, but was below a hundred thousand on all but three dates in the first four months. In September and October, however, the numbers varied from over five to over nine hundred thousand, and there was an average of over five individuals per leaf, as compared with one to two or three leaves in May.

Laboratory experiments were carried out in Ohio to ascertain the extent of the injury caused to apple leaves by these Jassids, use being made of material from the Indiana orchard. Allowing them to feed at the rate of 100 per leaf for 3 days reduced the rates of photosynthesis and transpiration by 23·2 and 15·8 per cent., respectively. From this it is inferred that 300 leafhopper-hours per leaf reduces these rates by 1 and 0·66 per cent. A further 9,600 leaf hopper-hours reduced the rates in the same leaves by 7·6 and 12·7 per cent. Feeding rates made on this basis to correspond to those estimated to have occurred in the orchard by 17th May, 25th June and 26th July showed percentage reductions in photosynthesis and transpiration of 16·5 and 4·9, 19·2 and 13·8, and 27·1 and 12·9, respectively. Since an injured leaf area does not recover, early infestation results in a reduced rate of photosynthesis for the remainder of the season. It is emphasised that a reduction of 20–50 per cent. in photosynthesis beginning early in the season can have a considerable adverse effect on the size and colour of the fruits and on the formation of the fruit buds that initiate the crop of the following year. Moreover, the leafhoppers are active carriers during the growing season of fire blight [*Bacillus amylovorus*].

Apart from the inclusion of nicotine in the spray schedule, the numbers of Jassids can be reduced by the removal of water sprouts and other thin wood in the centre and lower parts of the trees, and any branches that touch the dead leaves and grass, and by burning fence rows in spring.

Neiswander (R. B.). **Five troublesome Strawberry Pests.**—*Proc. Ohio hort. Soc.* **74** pp. 128–136. Columbus, Ohio, 1941.

Notes are given on the bionomics and control of five insects that attack strawberries in Ohio, of which the most important is *Ancylis comptana*, Froel. (*fragariae*; Walsh & Ril.) [*cf. R.A.E.*, A **26** 735]. The larvae of the Eumolpids, *Paria canella*, F., and *Colaspis brunnea*, F., feed on the roots and the adults on the leaves of strawberry. Examination in 1940 of samples of soil from a plantation at Wooster showed an infestation of 40 larvae per sq. ft. of soil surface, and over 65 per cent. of the larvae occurred within the upper 2 ins. of soil. The adults feed mostly at night or on cloudy days and hide among the foliage or in the surface mulch during bright sunshine. *P. canella* hibernates in the adult stage under rubbish or in sheltered places, and begins to feed and oviposit in late May or early June. *C. brunnea* hibernates in the egg stage ; the larvae feed during April and May, and the adults emerge in June. Severe infestations of either species take 2–3 years to develop, and they can be prevented by ploughing the beds under after the second year's crop is harvested, and by establishing new plantations at some distance from infested land. In experiments, the larvae were not controlled by the application to the soil of lead arsenate at the rates of 5, 15 or 25 lb. per 1,000 sq. ft. Dusting with either Dutox [barium fluosilicate and sodium fluoaluminate] or Kryocide [natural cryolite] at the rate of 1 part to 2 parts each of talc and flour reduced the injury significantly.

The other two pests dealt with are *Tyloderma fragariae*, Ril., which has not caused much injury in Ohio but is an important pest in Kentucky [*cf.* **26** 736],

and the Lygaeid, *Myodochus serripes*, Ol., which was recorded as injuring ripening strawberries in 1898 and 1899 in Ohio, and in the latter year also in Maryland and Virginia. Since 1936 it has been observed several times on everbearing strawberries in Ohio, and in 1940 it was abundant in a plantation after the berries had been picked. It has not appeared in numbers early enough in the season to cause any serious damage to the main crop.

Duarte (A. J.). **Determinação do número de estágios larvares da mosca da azeitona.** [Ascertainment of the Number of larval Instars of the Olive Fly.]—*Agron. lusitana* **3** no. 2 pp. 93–101, 1 pl., 16 refs. [Sacavem] 1941. (With a Summary in English.)

Larvae of *Dacus oleae*, Gmel., from olive fruits in Portugal, showed morphological differences in the mandibular hooks and spiracles. These differences made it possible to group individuals of all sizes in three distinct series, which suggests the existence of three larval instars. This was confirmed by measurements taken between definite points in the mandibular hooks.

Rosa de Azevedo (A.). **A *Cydia pomonella* L. e a sua biologia em Portugal.** [*C. pomonella* and its Biology in Portugal.]—*Agron. lusitana* **3** no. 2 pp. 129–136, 3 graphs, 8 refs. [Sacavem] 1941. (With a Summary in English.)

Observations on the biology of *Cydia pomonella*, L., in Portugal were made in the season of 1939 in the district of Chamusco and at Lisbon. The larvae hibernated on the trunks of apple, pear, and, especially, quince, between the root collar, where they were most numerous, and a height of about 6 ft. The pupal stage lasted 26 days in early spring and 17 days in May. Adult emergence began in early April and reached a peak between 10th and 15th May and another at the end of June ; it was closely related to temperature. The larvae of the first generation appeared from 16th May to the end of June and attacked less than 10 per cent. of the fruits. The second generation began to hatch in mid-July and the adults emerged from 14th August to 8th September ; the larvae attacked 50 per cent. of the fruits, including quinces, which are not infested by the first generation owing to their pubescent skins. Larvae of the third generation hibernated.

Ants and earwigs were the chief predators. About 10 per cent. of the material collected was parasitised by unidentified Hymenoptera, but an unidentified fungus was far more important and destroyed 20–100 per cent. of the hibernating larvae on quince trees that were growing in damp situations.

It is concluded that sprays need not be applied before mid-May or in early July, and that quinces need no protection from the first generation. Scraping the trunks, especially those of quince trees, considerably reduces the numbers of moths that emerge in spring.

Meuche (A.). **Zur Oekologie und Bekämpfung des grossen Rapsstengelrüsslers (*Ceutorrhynchus napi* Gyll.).** [A Contribution to the Ecology and Control of *Ceuthorrhynchus napi*.]—*Z. PflKrankh.* **52** pt. 1 pp. 1–29, 19 figs., 7 refs. Stuttgart, 1942.

An account is given of observations in the spring of 1941 on the bionomics of *Ceuthorrhynchus napi*, Gylh., on varieties of rape near Worms. The scanty literature on this weevil and the differences between it and closely allied species are reviewed. It occurs in central and southern Europe and in Algeria. With the possible exception of East Prussia, it is found throughout Germany, but predominates in the southern regions. Its food-plants are crucifers, chiefly varieties of rape. In 1941, the overwintered adults appeared in rape-fields in

mid-March. They fed on the stems and leaves, but such feeding is of no economic importance. Oviposition began early in April. The eggs were laid preferably in the tender, juicy tissue of the tip of the main shoot. The stem swells round the site of oviposition and a hollow develops in the pith. Affected stems become twisted, shortened and deformed. This injury is increased when the hollow portions split open, and the plants often bend over at such points. In 1941, the first young larvae were observed early in May, incubation having required a month owing to abnormally cold weather. While the egg and larval development of *C. quadridens*, Panz., takes place chiefly in the leaf-stalks, that of *C. napi* occurs almost exclusively in the stem and shoots of the plant, so that it causes more severe injury. The larvae mine in the main and lateral shoots, which sometimes rot internally, and if infestation is severe, the attack extends down the whole stem as far as the root-collar, which is usually left untouched. Pupation occurred at the end of June and early in July, in earthen cells in the ground. The duration of the egg and larval stages was influenced by the situation of the field, especially as regards altitude. The adults did not become sexually mature in the year of emergence, so that there is probably only one generation a year. Their winter quarters are unknown.

An Ichneumonid bred from pupae of *C. napi* received in July 1940 was identified as an undescribed species of *Thersilochus* by T. Kupka, and a list is given by him of five species of *Thersilochus* recorded from weevils. *C. napi* causes noticeable loss of crop only if the plants are in poor condition, chiefly owing to unfavourable weather. They should not be sown too densely or too sparsely, and a good top dressing of a nitrogenous fertiliser should be applied. In preliminary experiments, the adult beetles were rather resistant to contact insecticides.

VON WEISS-WICHERT (—). **Massenauftreten der Ahorneule** (*Acronycta aceris* **L.).** [An Outbreak of *Apatele aceris*.]—*Z. PflKrankh.* **52** pt. 1 p. 40. Stuttgart, 1942.

Apatele (*Acronicta*) *aceris*, L., is recorded as defoliating Norway maple [*Acer platanoides*] and horse chestnut [*Aesculus hippocastanum*] in the streets of Danzig in 1941 ; larvae were numerous in August, but had left the trees by mid-September. It was stated in a local newspaper that such attacks occur each year.

FREY (W.). **Versuche zur feldmässigen Bekämpfung des Rapsglanzkäfers mit Kontakt- und Frassgiften.** [Experiments on the Field Control of the Rape Beetle with Contact and Stomach Poisons.]—*Arb. physiol. angew. Ent. Berl.* **8** pp. 177–196. 1941. (Abstr. in *Z. PflKrankh.* **52** pt. 1 pp. 40–41. Stuttgart, 1942.)

In experiments in Germany on the control of *Meligethes aeneus*, F., the best results were given by a proprietary derris dust (Kümex) containing 0·8 per cent. rotenone, which gave complete mortality in 24 hours in the laboratory when applied at a rate equivalent to about 18 lb. per acre, and reduced the infestation of rape in the field by 90–95 per cent. in the same period when applied at 22·5 lb. per acre. In one field test, the dust was still effective 5 days after application. A dust containing derris and pyrethrum gave inferior results, and two organic stomach poisons and dusts and sprays of calcium arsenate were also unsatisfactory. When the derris dust was compared with the mobile trap of Buhl & Meyer [*R.A.E.*, A **27** 511], the percentages of control were 73 and 94, respectively, after 3 hours, and 95 and 58 after 24 hours. The dust has also proved effective in Germany against cabbage flea-beetles (*Phyllotreta*) and the rape flea-beetle (*Psylliodes chrysocephala*, L.).

Schwerdtfeger (F.). **Bekämpfung und Prognose der Kiefernschonungs-Gespinstblattwespe** *Acantholyda erythrocephala* **L.** [The Control and Forecasting of Infestation by *A. erythrocephala*.]—*Forstarchiv* **17** pp. 57–61. 1941. (Abstr. in *Z. PflKrankh.* **52** pt. 1 p. 43. Stuttgart, 1942.)

An arsenical dust proved effective against *Acantholyda erythrocephala*, L., on pines in a forest district in Prussia. The intensity of infestation can be forecast by the collection and examination of prepupae that have overwintered in the ground. The factors to be taken into account include parasitism, disease and, especially, the percentage of prepupae that remain in diapause, which is occasionally very high. The likelihood of an outbreak can be verified by egg counts.

Schimitschek (E.). **Die Massenvermehrung des Kiefernspanners,** *Bupalus piniarius* **L., und seine Bekämpfung im Jahre 1940 in der Westslowakei.** [The Outbreak and Control of the Pine Geometrid, *B. piniarius*, in 1940 in West Slovakia.]—*Zbl. ges. Forstwes.* **67** pp. 25–46, 53–59. 1941. (Abstr. in *Z. PflKrankh.* **52** pt. 1 p. 44. Stuttgart, 1942.)

An outbreak of *Bupalus piniarius*, L., occurred in 1937–40 on pines in West Slovakia. In 1939–40, the injury was aggravated by attack by *Diprion pini*, L. Counts of pupae and eggs of *Bupalus* were made for forecasting the course of the outbreak, and stands with more than 5 healthy pupae per square yard were considered in danger. The pupae were less common in low-lying parts of a stand than in the higher ones, and a difference in altitude of a few yards had a definite effect on their density. Parasitism of the eggs by *Trichogramma evanescens*, Westw., was practically negligible. Two proprietary dusts containing dinitro-ortho-cresol gave effective control in 1940 when applied from an aeroplane or from the ground, but caused some scorching when applied to trees wet with dew. Their effect on wild life in the forest is briefly discussed.

Nolte (H. W.). **Neue Erfahrungen zur Dyk'schen Nonnenanlockungsmethode.** [New Experiences with the Dyk Method for attracting Nun Moths.]—*Zbl. ges. Forstwes.* **66** pp. 197–206. 1940. (Abstr. in *Z. PflKrankh.* **52** pt. 1 pp. 46–47. Stuttgart, 1942.)

This is an account of experiments in Germany on the value in field work of Dyk's method of attracting the males of *Lymantria monacha*, L., by the scent of the females [*R.A.E.*, A **21** 299]. A paper cup covered with gauze was used to contain the female, and the males were caught on a band of oiled paper, coated with adhesive, placed round a tree trunk at a convenient height. The females were not attractive throughout their lives, and the greatest distance over tree-less ground from which males were attracted was about 770 yards. The results varied with the physiological condition of the female, weather and topography, but not with density of population. The method is therefore useless for making forecasts or effecting control, and can merely serve as an indicator of infestation, especially in ascertaining the beginning of an outbreak.

Börner (C.). **Wirtswechsel der Schlupfwespe** *Diospilus capito* **zwischen den Larven von Rapsglanzkäfer und Kohlblattrüssler.** [The Larvae of *Meligethes aeneus*, F., and *Ceuthorrhynchus leprieuri*, Bris., as alternate Hosts of the Hymenopterous Parasite, *D. capito*, Nees.]—*Z. PflKrankh.* **52** pt. 2–4 pp. 107–113, 9 refs. Stuttgart, 1942.

Since Braconids bred from *Meligethes aeneus*, F., *Ceuthorrhynchus pleurostigma*, Marsh. (*sulcicollis*, auct.) and *C. leprieuri*, Bris. (*obesulus*, Weise, *rübsaameni*, Kolbe) on rape in Germany were identified by Schmiedeknecht as *Diospilus oleraceus*, Hal., the author carried out investigations on the importance of this

parasite [*R.A.E.*, A **9** 549] and suggested that it should be bred from the galls made by *C. pleurostigma* and released in rape fields early in the season against *M. aeneus* ; this suggestion was supported by Kaufmann [**12** 26]. Fahringer later identified adults of *Diospilus* bred from *C. pleurostigma* as *D. oleraceus*, and Kaufmann and Riggert found that the latter breeds in *C. pleurostigma* throughout the year and that the species that attacks *M. aeneus* is distinct. It was not known whether the latter also parasitises the larvae of *C. leprieuri*.

In the autumn of 1940, the author collected leaf-galls of *C. leprieuri* from rape in the field in northern Bavaria and kept them on soil in pots. When the larvae had entered the soil, the plant parts were removed and the pots kept overwinter in an unheated laboratory. The first adult parasites emerged on 30th April 1941 and the first weevils on 11th May, after which date very few additional parasites appeared. Since most of the parasites emerged before the weevils, it was suspected that larvae of the latter are not their spring hosts. Inflorescences of rape in which *M. aeneus* had oviposited were then introduced into the cage, together with a few pairs of adults of this beetle to ensure a supply of freshly deposited eggs. The parasites oviposited in the inflorescences and had all died by 20th May. When the larvae of *M. aeneus* hatched, they were caged with rape plants and eventually entered the soil to pupate. Two females of *D. capito*, Nees, emerged from them in June, and the fact that the parasite of *M. aeneus* has an alternate host (*C. leprieuri*) in which it overwinters was thus confirmed.

It remains to be seen whether *C. leprieuri* can be used to breed *D. capito* for release against *M. aeneus*, and whether the parasite oviposits in the larvae as well as the eggs.

Goffart (H.), Frey (W.) & Ext (W.). **Grossbekämpfung des Rapsglanzkäfers (*Meligethes aeneus* F.) mit Derrisstäubemitteln in Ostholstein.** [Large Scale Control of the Rape Beetle, *M. aeneus*, with Derris Dusts in East Holstein.] —*Z. PflKrankh.* **52** pt. 2–4 pp. 113–131, 8 figs., 3 refs. Stuttgart, 1942.

In view of the good results given by Kümex, a proprietary derris dust with a low rotenone content [0·8 per cent.], against *Meligethes aeneus*, F., on rape [*R.A.E.*, A **30** 539], this material and another proprietary dust, L, with the same rotenone content were applied in May 1941 in East Holstein in fields of varieties of rape in which serious infestation by *M. aeneus* occur each year. The objects were to check the previous results, to improve methods of dusting, and to ascertain whether repeated applications could reduce infestation to an insignificant level.

Kümex proved satisfactory when applied over an area of about 200 acres at the rate of 22·5 lb. per acre, and the infestation had decreased by about 90 per cent. 1 day after treatment. The dust was applied from bags suspended from a 12-foot springy bar carried by two men, so that they hung between the rows. Knapsack dusters, used in one case, covered a smaller surface and produced a less uniform dust cloud than the bags. Three horse-drawn machines equipped with power dusters were also tested. They had canvas screens hinged to the sides and back, and these were lowered to a horizontal position, at any desired height above ground, to keep the dust down. For use in the rape fields, sacks were hung from the outer edges of the screens to enclose the plants. Kümex again gave good results, but the other derris dust was completely ineffective, and when tested subsequently in the laboratory at a rate equivalent to 27 lb. per acre, it gave an average percentage mortality of only 9 after one day and 17 after two days. A fourth horse-drawn machine, of Dutch design, was not available when the beetle was present, but it was found to give a good distribution of the dust. Features considered desirable in it are guards for the wheels, so that the plants cannot become entangled in them, adjustable separation of the wheels, which

also provide the driving power for the duster, and good clearance of the plants. The Buhl-Meyer mobile trap [**27** 511] gave only 56 per cent. reduction in infestation 19 hours after it was used.

A field was kept reasonably free from infestation by repeated dusting with Kümex up to the time of flowering. The dust was applied when counts showed that reinfestation was occurring, and the edges of the field required some extra dusting.

MEYER (E.). **Versuche mit chemischen Vergrämungsmitteln zur Verhinderung der Eiablage des Maikäfers auf landwirtschaftlich genutzten Flächen.** [Experiments with chemical Repellents to prevent Oviposition by Cockchafers in cultivated Ground.]—*Z. PflKrankh.* **52** pt. 2–4 pp. 131–153, 2 figs., 25 refs. Stuttgart, 1942.

The experiments described were carried out in 1938 in Holstein and Mecklenburg, where the cockchafer population consisted almost entirely of *Melolontha melolontha*, L., and in 1939 in a district in Württemberg near Lake Constance, where up to 40 per cent. of it was *M. hippocastani*, F. The substances tested included a tar-oil emulsion, several proprietary sprays of unstated composition, by-products of coal distillation and fishmeal, but the only one of any value was naphthalene (either as flakes or in a crude form) which remained repellent for several days. A powdered naphthalene lost its effectiveness very rapidly. The product was found to be effective only so long as its smell could easily be detected at least 6 ft. above the ground. When applied at the rate of 44·5 lb. per acre, naphthalene was repellent for 4–5 days, so that the treatment would have to be repeated 5–6 times even in favourable years when the oviposition period is short. Its effectiveness depended greatly on the physiological condition of the beetles and on the weather. Early in the oviposition period the females flew readily, and the effect of the repellent was marked. As the oviposition period advanced, they flew less readily, and even large, fresh doses failed to repel them. Cold and, especially, wet weather checked the evening flight and the reactions of the beetles. Moreover, naphthalene lost its smell almost completely when wetted, so that treatment after rain was ineffective until the ground dried out.

KOTTE (W.). **Ueber Schäden durch *Orchestes fagi* L. und *Psylla costalis* Flor am Apfel.** [On Injury to Apple by *Rhynchaenus fagi* and *P. costalis*.]—*Z. PflKrankh.* **52** pt. 2–4 pp. 153–159, 6 figs., 10 refs. Stuttgart, 1942.

Rhynchaenus (*Orchestes*) *fagi*, L., is common in Germany and normally infests beech, but the adults occasionally feed on cereals, cauliflower, berry bushes and fruit trees. In June 1940, the weevils were observed feeding on apple fruits in a locality on the German side of Lake Constance, and about 40 per cent. of the fruits had been damaged by harvest. It has been stated that such injury is caused by the young adults of the first generation, but the author considers it doubtful whether these had emerged as early as June. Overwintered adults that had left their winter quarters late were possibly responsible. Feeding results in circular holes on the surface of the fruits, which sometimes become deformed. On 8th June the trees were sprayed with a combination of Bordeaux mixture, lead arsenate and nicotine, and adult feeding ceased at once, probably owing to the effect of the nicotine. In 1941 the weevil was rare in the orchard.

An outbreak of *Psylla costalis*, Flor, occurred on apple in orchards in the Breisgau and Lake Constance regions of Germany in 1941, and data on this Psyllid are reviewed from a recent paper by Wiesmann [*R.A.E.*, A **27** 232].

MAERCKS (H.). **Ueber Schadauftreten und Lebensweise der Graseule** (*Charaeas graminis* **L.), sowie Bemerkungen über Wurzeleule** (*Parastichtis* (*Hadena*) *monoglypha* **Hufn.) und Lolcheule** (*Epineuronia popularis* **F.).** [The Harmfulness and Biology of *C. graminis*, with Notes on *Trachea monoglypha* and *Tholera popularis*.]—*Z. PflKrankh.* **52** pt. 2–4 pp. 159–182. 8 figs., 5 refs. Stuttgart, 1942.

Brief descriptions are given of the larvae of *Charaeas graminis*, L., *Trachea* (*Parastichtis*) *monoglypha*, Hfn., and *Tholera* (*Epineuronia*) *popularis*, F., which are sporadic pests of grasses in Germany, and of the egg and adult of *C. graminis*, a severe outbreak of which occurred in the river lowlands of north-western Germany in 1941. The larvae of these Noctuids attack the grass plants about an inch above the ground, causing the upper portion to fall over and wither. The remaining stump is eaten down to ground level, and several plants are destroyed by each larva. A map is given showing the localities in Germany from which injury by *C. graminis* and *T. monoglypha* has been recorded, together with details of infestations by *C. graminis* in 1940 and 1941. Where they were most severe, the first crop of hay was completely destroyed, and the areas involved ranged from 5 to 125 acres. In less severe attacks, some 20–50 per cent. of the crop was lost. Dry weather increases the injury by scorching the bare surfaces and thus causing the second hay crop to fail. Abundant rain in June and July revives the grasses, and a good second crop may be obtained. Observations in 1940 and 1941 indicated that outbreaks of *Charaeas* are favoured by cold winters and cool summers, and those of *Trachea* by mild winters and hot summers. The larvae of *Charaeas* were injurious in May, and in 1941 they pupated between early June and early July. The adults were observed from early July to mid-August, but were most abundant in the first half of July; the ratio of males to females in moths bred from pupae collected in the field was 3 : 2. The adults lived for an average of 7 days at room temperature and without food. The average numbers of eggs laid per female in the two years were 184 and 148. It has been stated that the eggs of *C. graminis* hatch in the year in which they are deposited, but the majority of those collected by the author in 1940 hibernated. Subsequent experiments showed that eggs transferred to the laboratory when 1–2 days old and kept at 12–36·5°C. [53·6–97·7°F.] had not hatched after 12 weeks, so that a diapause is obligatory. High temperatures were unfavourable to the eggs when humidity was low, and even at 100 per cent. relative humidity all those kept at 28·5°C. [83·3°F.] died; all temperatures above 22°C. [71·6° F.] had an adverse effect. Further experiments confirmed that the eggs are favoured by high humidity.

A few experiments on control were made, though only mature larvae about to pupate were available. When larvae dusted with preparations containing pyrethrum or derris were transferred to untreated grass sod, the percentage mortality did not exceed 50 in 9 days, but when the larvae were dusted with one derris preparation or calcium cyanamide on the sods, it was 74 and 78, respectively. Field experiments gave inconclusive results. It was observed, however, that ditches containing water proved effective barriers to the larvae, and that dry trenches about 1 ft. deep with vertical sides trapped all the larvae that fell into them.

GÖSSWALD (K.). **Ueber verschiedene grundsätzliche Wege, die sich zur Ameisenbekämpfung eignen.** [On various fundamental Methods suitable for Ant Control.]—*Z. PflKrankh.* **52** pt. 2–4 pp. 182–192, 9 refs. Stuttgart, 1942.

This is a discussion of the ways in which the habits of ants facilitate or prevent their being controlled by various methods. Poison baits offer the best chance of success, since they are distributed through the nest by the ants

themselves, but they do not affect the pupae, so that several applications are required. All stages can be destroyed by introducing hot dry air, liquid insecticides or fumigants into the nests, but the latter are generally situated deep in the ground or in the walls of buildings and are thus largely inaccessible. Fumigants are suitable for treating infested aircraft, railway waggons and other means of transport. Fungous diseases, which destroy all stages, are favoured by the high humidity and the crowded life in the nest, but the ants remove dead individuals and thus reduce the chances of a general infection. The method of control to be selected will therefore depend on the circumstances of each individual case.

BLUNCK (H.). *Leptophyes punctatissima* **Bosc als Rosenschädling.** [*L. punctatissima* as a Pest of Roses.]—*Z. PflKrankh.* **52** pt. 2–4 pp. 192–204, 11 figs., 8 refs. Stuttgart, 1942.

Few records exist of damage to economic plants by Tettigoniids in Germany. Occasional injury to cereals and pasture grasses has been caused by *Decticus verrucivorus*, L., and *Tettigonia viridissima*, L., and the latter has also attacked many other plants, including vines, tomatos, beans, lucerne and potatoes. *Pholidoptera cinerea*, L., has been recorded as injuring Douglas firs [*Pseudotsuga taxifolia*] in Brunswick [*R.A.E.*, A **18** 435]. *Tachycines asynamorus*, Adel., which was introduced from Japan, is a pest of greenhouse plants. In 1941, *Leptophyes punctatissima*, Bosc, was observed injuring the petals and leaves of roses at Godesberg on the Rhine. The habits and distribution of this Tettigoniid are reviewed from the literature [**9** 257 ; **19** 373]. The adults were present in August and early September and were found mostly in places sheltered from the wind ; in cage experiments they proved highly polyphagous.

HÄHNE [H.]. **Untersuchungen über den Speisebohnenkäfer** *Bruchidius* (*Acanthoscelides*) *obtectus* **Say.** [Investigations on *Bruchus obtectus*.]—*Mitt. biol. Reichsanst.* no. 63 pp. 75–76. 1941. (Abstr. in *Z. PflKrankh.* **52** pt. 2–4 pp. 238–239. Stuttgart, 1942.)

In central Germany, *Bruchus* (*Bruchidius*) *obtectus*, Say, has been found ovipositing in beans in the pod, so that there is a risk of beans being infested when they are brought to a store from the field. Germisan [a proprietary preparation containing mercury and used for treating seeds] prevented infestation. Infested beans exposed for an hour to −15°C. [5°F.] and for a month to temperatures between −5 and 0°C. [23 and 32°F.] gave rise to healthy beetles.

SPEYER (W.). **Untersuchungen über tierische Obstschädlinge und ihre Bekämpfung.** [Investigations on Insect Pests of Fruit and their Control.]—*Mitt. biol. Reichsanst.* no. 63 pp. 78–79. 1941. (Abstr. in *Z. PflKrankh.* **52** pt. 2–4 p. 239. Stuttgart, 1942.)

Observations in the orchard districts on the Lower Elbe showed that in spite of the tendency of *Operophtera* (*Cheimatobia*) *brumata*, L., to form races [*cf. R.A.E.*, A **26** 420], larvae from an orchard annually treated with arsenical insecticides and from a wood proved equally susceptible to arsenic.

Winged individuals of the woolly apple aphis, *Eriosoma* (*Schizoneura*) *lanigerum*, Hsm., produced fewer progeny than wingless ones. The Aphids were able to resist dry cold down to −17°C. [1·4°F.], but were killed by rime frost even at a few degrees below freezing point. Development and reproduction were arrested at 7°C. [44·6°F.] and were impaired at 30°C. [86°F.]. Parasitism by *Aphelinus mali*, Hald., in 1939 did not exceed 68 per cent., since the

parasite requires more warmth than its host. Infestation of apple by *Anthonomus pomorum*, L., and *Cydia pomonella*, L., in a district in which tits had been encouraged was reduced by 60 and 75 per cent., respectively, as compared with a control area.

Roos (K.). **Schädlinge an Hackfrüchten und Getreide in Beziehung zum Mehranbau.** [Pests of Root and Cereal Crops in Connection with increased Cultivation.]—*Mitt. schweiz. ent. Ges.* **18** pt. 7–8 pp. 353–360. Berne, 1941.

Brief notes are given on pests that cause losses of agricultural crops in Switzerland. Since its appearance there in 1937, the potato beetle, *Leptinotarsa decemlineata*, Say, has spread through the country, until, by the end of 1940, there were only five cantons in which it had not been found. In August 1940, a fall in temperature to 8°C. [46·4°F.] caused the adults to disappear underground, and they did not reappear when the weather became warmer. Energetic control measures are necessary, as the beetle reproduces rapidly, and even the abnormally cold winter of 1939–40 failed to eradicate it. The fields should be inspected every 10–14 days and infested areas sprayed with arsenicals. Potato virus diseases are carried by *Myzus* (*Myzodes*) *persicae*, Sulz., and other Aphids. The winter eggs of *M. persicae* on peach can be destroyed by sprays, but the early appearance of the Aphid in localities in which there are no peach or apricot trees proves that it can overwinter in their absence.

Beet is attacked by *Cassida nebulosa*, L. The adults hibernate in the soil or under leaves, and feed and oviposit in spring on *Chenopodium* and *Atriplex*, from which sugar-beet and mangels are infested. Infestation can be reduced by clean weeding. In experiments, derris dust and a spray containing 4 per cent. barium chloride and 1 per cent. calcium caseinate proved more effective than lead arsenate. In August–September 1940, turnips in three cantons were defoliated by *Athalia rosae*, L. (*spinarum*, F.). The adults emerge in May and oviposit on various crucifers. The egg, larval and pupal stages require 6–10 days, 3–4 weeks and 3 weeks, respectively. The summer adults emerge in August, and the larvae of the following generation injure turnip and varieties of cabbage. Derris dusts have proved effective against them and are safe to use on plants destined for human or animal consumption. *Gryllotalpa gryllotalpa*, L. (*vulgaris*, Latr.) and cutworms cause damage chiefly to maize and tobacco. A bait of broken rice poisoned with barium fluosilicate is effective against the mole-cricket, and one of bran poisoned with sodium fluosilicate or Paris green against the cutworms.

The principal pests of cereals are *Oscinella frit*, L. [*cf. R.A.E.*, A **25** 609] and *Chlorops pumilionis*, Bjerk. The latter infests winter cereals (wheat, rye and barley) that have been sown too early. The adults emerge from mid-May onwards and oviposit after 4–5 days. The larvae mine in the stem between the ear and the top node, causing it to thicken and shorten and reducing the yield of the ear by about 40 per cent. Varieties that formed the ears early and had thin stems and narrow leaves were less injured than others.

Lotmar (R.). **Ueber eine Mikrosporidieninfektion (Gattung *Nosema*) bei der Kleidermotte, *Tineola biselliella*.** [Infection by a Microsporidian of the Genus *Nosema* in the Clothes Moth.]—*Mitt. schweiz. ent. Ges.* **18** pt. 7–8 pp. 361–371, 3 figs., 8 refs. Berne, 1941.

An account is given of detailed observations on the Microsporidian found parasitising larvae of *Tineola biselliella*, Humm., at Basle [*cf. R.A.E.*, A **29** 376], and it is confirmed that it belongs to the genus *Nosema*. The spores are described. The parasite was found in all the organs of the body. The larvae show no external signs of infection, but their growth and activity are checked

and some are killed. Pupae and adults are also parasitised, and in experiments, infected females transmitted the parasite to their progeny. Healthy larvae supplied with infected food acquired the infection.

LOTMAR (R.). **Die Polyederkrankheit der Kleidermotte** (*Tineola biselliella*). [The Polyhedral Disease of the Clothes Moth.]—*Mitt. schweiz. ent. Ges.* **18** pt. 7–8 pp. 372–373, 1 fig. Berne, 1941.

Larvae of *Tineola biselliella*, Humm., were observed in Basle to be infected with polyhedral disease, and the polyhedral bodies in them were very similar to those that occur in silkworms [*Bombyx mori*, L.]. Larvae were easily infected by ingesting wool contaminated with crushed, infected larvae. Diseased larvae usually died, but one gave rise to an adult. It was a female, and its progeny were not infected.

FERRIÈRE (C.). **Les parasites de la teigne des vêtements.**—*Mitt. schweiz. ent. Ges.* **18** pt. 7–8 pp. 374–377, 1 fig. Berne, 1941.

Parasites reared from *Tineola biselliella*, Humm., at Basle comprise *Apanteles carpatus*, Say, *Meteorus atrator*, Curt., and a species of *Tetrastichus* that parasitises the larvae [*cf. R.A.E.*, A **29** 375] and is here described from the adults of both sexes as *T. tineivorus*, sp. n. Brief notes are given on the morphology of the first two species, and it is pointed out that *A. carpatus* has been recorded in Japan [*cf.* **22** 376], where it was reared from *Tinea pellionella*, L., as well as from the United States [*cf.* **29** 376], where it is known as a parasite of *T. pellionella* and *Trichophaga tapetzella*, L.

DANIELS (L. B.). **Colorado Potato Pests.**—*Bull. Colo. Exp. Sta.* no. 465, 28 pp., 9 figs., 10 refs. Fort Collins, Colo., 1941.

The information on the more important pests of potato in Colorado given in the main part of this bulletin is substantially the same as that in an earlier one [*R.A.E.*, A **26** 643], but the section on spraying and dusting equipment is omitted. Notes are included on blister beetles, which do considerable damage when abundant and can be controlled with sprays containing zinc arsenite; on Aphids, which have occasionally appeared in sufficient numbers to be potentially harmful, particularly since they are vectors of virus diseases; on wireworms, which cause considerable injury to potatos in some sections of the State; and on *Chlorochroa sayi*, Stål, which did serious damage in 1939 [*cf.* **29** 596]. The population of this Pentatomid was appreciably reduced by pyrethrum dust, but it is doubtful whether the crop justifies the expense involved. In the past few years, grasshoppers have migrated to potato from adjacent lucerne when it was cut or from pasture when it dried up, and caused severe defoliation; the combined spray of zinc arsenite and lime-sulphur [**26** 643] is reported to give complete protection against them.

Fifty-fourth Annual Report 1940–41. Colorado Agricultural Experiment Station.—62 pp. Fort Collins, Colo., 1941.

In the section of this report (pp. 23–26) dealing with work carried out or in progress on insect pests during the year ending 30th June 1941, it is recorded that grasshoppers were again the chief problem [*cf. R.A.E.*, A **29** 596], but that a campaign against them was successful. The Lamiid, *Moneilema annulata*, Say, which kills many cactus plants when abundant, and thus aids range improvement, was reported in the vicinity of Colorado Springs. Several strains of potato showed resistance to Psyllid yellows, caused by the feeding of the Psyllid [*Paratrioza cockerelli*, Šulc].

Hamner (A. L.). **Fruiting of Cotton in Relation to Cotton Fleahopper and other Insects which do similar Damage to Squares.**—*Bull. Miss. agric. Exp. Sta.* no. 360, 11 pp., 2 figs., 6 refs. State College, Miss., 1941.

In experiments carried out in Mississippi from 1936 to 1939 to determine whether cotton plants could overcome the loss of young squares caused by attack by *Psallus seriatus*, Reut. [*cf. R.A.E.*, A **18** 64] early in the season, the damage was simulated by removing all the squares from six sets of plants 1–6 times at weekly intervals. The first picking was made four days after half the plants had visible squares, the date varying with the year from 17th June to 8th July. The potential ability of the plant to produce new squares was shown by the fact that the total numbers of squares removed in four or more pickings were greater than the number of blooms produced on untreated plants. The treated plants tended to have shorter blooming and fruiting periods and to produce more flowers and bolls than untreated ones, were taller and had longer branches; there was a slight decrease in the size of the bolls and the staple length. It was found that the yield of seed cotton was not directly associated with the number of flowers or bolls produced. The complete loss of squares up to the end of the third week in July did not cause a significant reduction in yield when the fruit was protected from the boll weevil [*Anthonomus grandis*, Boh.] and other insects and there was negligible disease, but such plants produce their fruit when it may be subjected to heavy boll-weevil infestation and late summer drought; plants that have lost all their squares for five or six weeks may become top-heavy and fall over. The third week in July was the latest date for loss of squares that allowed the plants to produce a crop of cotton if a heavy frost occurred fairly early in the autumn.

It is concluded that it is unnecessary to protect the young squares before the first week in July, unless infestation is so severe that vegetative buds are destroyed, but control should be begun during this week unless there is a decided decrease in the insect population.

Cook (W. C.). **The Beet Leafhopper.**—*Fmrs' Bull. U.S. Dep. Agric.* no. 1886, 21 pp., 11 figs. Washington, D.C., 1941.

A comprehensive account is given of the bionomics, ecology and control of *Eutettix tenellus*, Baker, the vector of the virus [*Chlorogenus eutetticola* of Holmes] that causes curly-top disease of beet and western yellow blight of tomato in the western United States. The principal breeding grounds of this Jassid, the sugar-beet areas affected by migration from them, and the general direction of the spring migrations are shown on a map. The six general breeding areas, which appear to be nearly independent of each other, are in Washington and Oregon; California; southern Idaho; Utah, Nevada and north-western Arizona; southern Arizona and western Colorado; and New Mexico and western Texas. All the breeding sites are situated in arid country with a mean annual rainfall not exceeding 10–12 ins.; summer conditions are hot and dry in all of them, and the heaviest rainfall occurs in winter and spring in all except Arizona, New Mexico and western Texas. The extent to which sugar-beet and other crops are damaged and the seasonal movements of the Jassids in each area are discussed, the latter with reference to the food-plants and seasonal climatic conditions [*R.A.E.*, A **20** 608; **25** 715, 756; **26** 322; **27** 286, 593].

Considerable control of *E. tenellus* is afforded by natural enemies. Large numbers of eggs are destroyed by Hymenopterous parasites, which also attack the eggs of other Jassids. The nymphs and adults are parasitised by various Hymenoptera and Diptera, the most important being *Pipunculus* spp., including *P. subnitens*, Cress., which are widely distributed and have occasionally been recorded parasitising nearly 66·6 per cent. of the Jassids. The eggs are deposited on or in the host, and the larvae overwinter within it, thereby reducing the spring

populations, since parasitised females of *E. tenellus* rarely oviposit. Several species of *Gonatopus* also oviposit in the Jassids, and in addition are predacious on them. Other natural enemies comprise predacious bugs, which are probably as important in control as the parasites, and spiders, lizards and birds.

Preventive measures include the use of resistant varieties of sugar-beet, bean, squash and pumpkin, and the control of wild food-plants by restricting grazing and cultivating neglected land [**20** 725 ; **25** 715], so that a natural cover is encouraged, and, in the case of Russian thistle (*Salsola pestifer*), by direct mechanical methods. Beet planted in the Sacramento Valley of California during January and February generally escapes serious damage from curly-top, whereas that planted during March–April does not ; in the coastal districts of California, plantings can be made after the spring migration has taken place, but this is advantageous only where summer breeding sites are unimportant. Elsewhere in the West, early planting reduces damage by curly-top to some extent but is not always satisfactory for other reasons. Young plants set out in December and January in fields where they are to be grown for seed should be raised in areas free from infestation. In California and other regions with long growing seasons that are near spring-breeding sites, tomato should not be planted until after the spring migration. Infestation on beet grown for seed can be reduced by an atomised oil spray containing pyrethrum extract, but direct control measures applied to sugar-beet shortly after the spring migration have been of little value. In many parts of California, where the Jassids congregate on patches of perennial weeds in autumn, large numbers can be destroyed by an atomised spray containing the extract of ½–1 lb. pyrethrum flowers in 1 U.S. gal. diesel fuel oil applied at the rate of 5–7 U.S. gals. per acre [*cf.* **21** 593]. This measure has been carried out, chiefly in the northern and central foothills of the Coastal Range, every year since 1931 with specially designed equipment, which is described, and has resulted in a regular control of over 90 per cent. Estimates of the populations in these areas and in the valleys to which the Jassids migrate from them indicate that 50–66·6 per cent. of the population is destroyed by this method.

FRIEND (R. B.). **Connecticut State Entomologist, Fortieth Report, 1940.**— *Bull. Conn. agric. Exp. Sta.* no. 445 pp. 295–384, 2 maps, 4 figs., 5 refs. New Haven, Conn., 1941.

Insect pests observed in Connecticut during the year ending 31st October 1940 are recorded by R. B. Friend (pp. 295–297), with brief notes on their importance. M. P. Zappe (pp. 308–310) reviews the results of inspection of nurseries and greenhouses for the presence of *Popillia japonica*, Newm., and states that 83 towns are now known to be infested [*cf. R.A.E.*, A **29** 161]. Friend, J. T. Ashworth and O. B. Cooke (pp. 313–321) report on work in connection with the control of *Lymantria* (*Porthetria*) *dispar*, L. Work on parasites is surveyed by P. Garman, J. C. Schread, W. T. Brigham and G. R. Smith (pp. 328–333). A total of 119 colonies (representing 66,185 individuals) of *Macrocentrus ancylivorus*, Rohw., was liberated against *Cydia* (*Grapholitha*) *molesta*, Busck, on peach. On the whole, egg and larval parasitism was low in June and high during July, and there was great variation from orchard to orchard. Collections made in August from corrugated paper bands removed from the trunks before the moths emerged indicated that many parasites were present and that hyperparasites were rare ; the rate of parasitism varied from 3·7 to 92·4 per cent. *Angitia* (*Inareolata*) *molestae*, Uch., was recovered from 8 orchards and seemed able to survive longer than had been believed [*cf. loc. cit.*]. *Microdus* (*Bassus*) *diversus*, Mues., was recovered in only one orchard. *Tiphia vernalis*, Rohw., was recovered in six localities in which it had been released against *Popillia japonica*, and 25 more colonies were liberated.

In the course of continued studies on adhesives for lead-arsenate sprays on apples by Garman and E. C. Shepard (pp. 333–336), it was found that white oils in " dynamite " (inverted) sprays can be emulsified with a combination of aluminium acetoborate and benzoic acid, the modified formula being 1 lb. aluminium acetoborate, $\frac{1}{4}$ lb. benzoic acid, 1 U.S. quart oil and $1\frac{1}{2}$ lb. lead arsenate (doubled at the calyx spray) in 50 U.S. gals. water. When applied three times for the control of *Rhagoletis pomonella*, Walsh, *Cydia* (*Carpocapsa*) *pomonella*, L., and the curculio [*Conotrachelus nenuphar*, Hbst.], it proved as effective as the ordinary western " dynamite " spray, prepared with monoethanolamine and oleic acid [*cf.* **25** 652] and containing the same concentrations of lead arsenate and oil. Unlike the latter, it caused no leaf drop, which resulted in larger fruits at harvest.

Experiments are recorded by Garman (pp. 336–339) in which Genicide, a material that was found to contain xanthone [*cf.* **29** 411], was tested in sprays against *Cydia molesta* on peach. The spray contained 2 lb. Genicide per 100 U.S. gals. water ; when it was applied in two orchards 4 times on 5th, 13th and 23rd August and 10th September, the average percentages of fruits showing new injury were 9·2 and 1·5 in sprayed plots and 28·8 and 3·8 in unsprayed ones, and when it was applied in a third orchard in August only, the percentages were 28 and 54·6. In laboratory tests, small green apples were punctured with about 30 holes each, sprayed with Genicide or 3 lb. lead arsenate per 100 U.S. gals. and artificially infested with eggs of *C. molesta* ; the percentages of larvae that entered and later emerged to pupate averaged 6·8 and 47·4, respectively, as compared with 54·2 in the controls, and in another test the average percentages of larvae that entered the apples were 9·4 for Genicide, 34 for lead arsenate and 44·1 in the control.

In investigations on the control of *R. pomonella* on apples, by Garman (pp. 339–346), the resistance to artificial sunlight of stabilised and ordinary derris dusts was tested. For this purpose an S_4 Mazda bulb producing ultra-violet rays said to be considerably stronger than sunlight was used, and the dust was applied to small glass slides, which were placed 12 ins. from the bulb. The derris was mixed with pyrophyllite as a carrier, and in one series it was impregnated with white lubricating oil. After exposure of 2–20 hours the slides were placed with the dusted side inwards to form the windows of cages containing adults of *R. pomonella*, and counts of the dead and paralysed flies were made after 24 and 48 hours. The results did not show any significant differences in favour of the stabilised derris or the dusts containing oil. In tests of a number of materials added to derris dust to reduce the effect of light, dusts containing 90 per cent. ferric hydroxide appeared superior to those containing 10 per cent. lamp black and 80 per cent. pyrophyllite, but the most promising results were obtained with 90 per cent. of a red clay, known as Hall clay. Chemical analyses of the dusts showed that rotenone was less rapidly destroyed when the carrier was the red clay than when it was pyrophyllite, the reductions in rotenone content after 24 hours exposure averaging 28·6 and 57·3 per cent., respectively. Field experiments with oil-impregnated derris dusts containing 0·5 per cent. rotenone showed that they are of value for late-season work, though the flies were rapidly destroyed during only 4 or 5 days, after which there was loss of effectiveness. Five applications in July and August of an oil-impregnated dust of derris and pyrophyllite reduced the infestation of picked and dropped fruit to 7·2 and 25·9 per cent., respectively, as compared with 87·5 per cent. for both together in untreated plots, and six applications in another orchard resulted in a percentage infestation of 63·7 as compared with 99·3 in the control.

A severe outbreak of *C. pomonella* in a large apple orchard in southern Connecticut is recorded by Garman (pp. 347–348]. This moth is not usually numerous in the State, which may be due to low temperatures at sunset or to the presence of natural enemies. The only other outbreak recorded was in 1871–73, and both this and that of 1940 occurred in periods of several years of

abnormally high summer temperatures. Increases in infestation were observed in several orchards.

With a view to improving the effectiveness of treatments against *Pyrausta nubilalis*, Hb., on maize, investigations were made on the distribution of the larvae in the plants at different stages of growth, the results of which are described by R. L. Beard (pp. 348–356). In observations on the first generation, maize plants on which only the first eggs of the moth were allowed to hatch were dissected at intervals of 5 days, or (in another series) when the plants had early ear shoots or ears in silk, at harvest, and when the grains reached the hard dough stage. The percentages of larvae occurring in the different parts of the plant at these intervals are shown in tables. It was found that, irrespective of the site of oviposition, the larvae tended to distribute themselves over the whole plant. The main stem appeared, however, to be more attractive to them, and larvae established in it showed little tendency to leave. Dissection of the plants at different stages of growth showed that during the first three phases there is an increasing concentration of the larvae in the ears, ear shoots, adjacent parts of the stalk and tillers, coinciding with a progressive decrease in the proportion of larvae found in the other parts of the main stalk. Examination of 100 infested ears at harvest showed that the larvae had entered 57 of them through the exposed portion of the husk, 39 at the area of contact between the ear and the stalk, 3 by way of the silk and 1 through the shank. In further experiments, only eggs deposited in certain successive periods were allowed to hatch. They showed that during the first three stages of plant growth, the chief infestation occurs primarily in the tassel, in which the larvae remain embedded until the third or fourth instar, when they migrate downwards. The subsequently developing ears become infested by migrant larvae from the tassels. If, however, the larvae hatch when ear shoots are present, the latter become primarily infested and the tassels do not attract the larvae. Data on the trend of oviposition indicated that about 30 per cent. of the eggs of the first generation presumably hatched before the ear shoots were present on the plants, and the resulting larvae infested the ears secondarily. The peak of oviposition occurred between 17th and 20th June, and the larvae that hatched subsequently infested the ears directly. The same occurred in the case of the second generation on maize planted about 25th June and 2nd July; by the time the larvae started to feed, the plants were well developed and the ear shoots were appearing.

N. Turner (pp. 357–361) gives the results of studies of the effectiveness against *P. nubilalis* of commercial dusts of derris (containing 1 per cent. rotenone) or dual-fixed nicotine (containing not less than $3\frac{3}{4}$ per cent. nicotine) carried out on small plots of sweet maize during a large-scale field experiment [*cf.* **30** 129]. The infestation was lower than in previous years owing to a cool spring and cold weather late in June. In treatments against the first generation, the plants were dusted 4 times at intervals of approximately 5 days beginning on 11th June. Dual-fixed nicotine proved more effective than derris, and dusting from a knapsack bellows duster was better than machine treatment. In another series, 4 applications at intervals of 5 days beginning on 13th June were more effective than 3 applications at intervals of a week. Encouraging results were given by spraying the ears alone with 1 lb. pure ground derris root (4·7 per cent. rotenone) and 2 oz. " Ultrawet " spreader in 25 U.S. gals. water, on 28th June, when young ear shoots had formed, 8th July, just prior to silking, and 15th July, when the ears were in full silk. This method is less expensive than the standard applications of sprays or dusts. In tests against the second generation, carried out in August and September, there was no difference in effectiveness between 5 applications of the dual-fixed nicotine dust at intervals of 5 days beginning on 12th August and 4 at intervals of 7 days. Machine dusting gave considerably better results than hand application. Derris and a proprietary pyrethrum dust were less effective than the nicotine. In the case of

both generations, the differences between applications to wet or dry foliage were not statistically significant, but the results indicated that the evening may be as satisfactory a time for treatment as the early morning.

In a brief account of experiments since 1938 on the control of *Hylemyia brassicae*, Bch., on cabbage by means of dusts containing mercurous chloride (calomel) in an inert carrier, Turner (pp. 361–363) states that in 1940 a 4 per cent. dust applied in April to the surface of the soil round the stem of each plant immediately after setting gave satisfactory results; the number of heads and total yield were significantly superior to those in untreated plots, but not significantly different from those given by a similar application of an 8 per cent. dust or two surface applications in May, during the oviposition period of the fly, of a 4 per cent. dust. The fact that the total amount of the latter applied was only slightly more than half that of the 4 per cent. dust applied at planting time indicates that the rate of application of the latter (106 lb. per acre) might be reduced. Treatment at planting time enables planting and treatment to be completed in one operation.

J. P. Johnson states (pp. 363–367) that owing to cold weather in April–June 1940, the adults of *Popillia japonica* began to emerge from the soil about a fortnight later than usual. They did not become numerous until 11th July, and in some localities were abundant until October. Both populations and the areas defoliated were greater than in previous years; the trees fed on included nectarine, plum and peach. A list is given of the ornamental trees and shrubs that were protected by an application in July of a spray containing 6 lb. lead arsenate, 4 lb. wheat flour and 1 U.S. quart soy-bean oil per 100 U.S. gals. water. Adequate protection was also afforded when the amount of lead arsenate was reduced to 4 lb. and when the soy-bean oil was omitted. A spray of 6 lb. pure ground derris root (4 per cent. rotenone) and 1 U.S. quart resin residue emulsion per 100 U.S. gals. water also gave protection, provided that the trees were treated every 5–6 days. Sassafras was protected for about two weeks by a spray of 2 lb. tetramethyl thiuram bisulphide and 2 lb. phenothiazine [thiodiphenylamine] per 100 U.S. gals. water. In an experiment in which this mixture was applied to grape vines in the first week of July, when the beetles were about to emerge, and on 16th July, when they were becoming numerous, the vines were kept comparatively free from infestation, and enough of the older foliage remained to enable the grapes to mature.

Otiorrhynchus (*Brachyrrhinus*) *sulcatus*, F., is spreading in nurseries in Connecticut, and observations on its bionomics and control are recorded by Johnson (pp. 367–369). When heavily infested *Taxus* plants were examined at the end of May, larvae and pupae were found in the soil beneath them and adults in the débris on the soil. Larvae and pupae comprised 60·66 and 38·07 per cent., respectively, of the total population; most of the former were fully grown or in the prepupal stage, and the latter in an early stage of development. The adults found had evidently overwintered. Adult emergence from the soil was intense by 20th June; most of the weevils occurred in the leaves and débris on the ground close to the trunks, but some sheltered in débris in the crotches of the trees. They feed on the leaves of *Taxus*, and the larvae feed on the roots, causing the foliage to turn yellowish; severe damage causes leaf drop and sometimes kills the tree. In experiments on control, the treatments were applied as the weevils were emerging. A spray of 5 lb. lead arsenate per 100 U.S. gals. water and baits of bran or apple flakes containing sodium fluosilicate placed under the trees were more effective than lead arsenate mixed with the soil under the plants at the rate of 3 lb. per 100 sq. ft. or a bait of bran and calcium arsenate, but all treatments showed some effectiveness.

Experiments in a pine forest on the control of the mound-building ant, *Formica exsectoides*, Forel, are summarised by Johnson and Friend (pp. 370–372). Mounds of varying size occurred in areas exposed to sunlight, and the treatments were carried out at the beginning of August, when the soil temperature

at a depth of 3½ ins. was 72°F. Approximately six weeks later the colonies were dead in the three mounds to which methyl bromide had been applied through holes or by pouring it evenly on the top after removing the upper layer of the mound, which was then replaced. Carbon bisulphide, applied through holes to two mounds, was effective in the smaller one, but not in the larger. Encircling a large mound with a band about 1 ft. wide of pure ground derris root containing 4 per cent. rotenone practically exterminated the colony. This method seems to be the most suitable for practical use, and further trials with it would be justified. Covering the mounds with pine boughs in a layer 12–18 ins. thick to shade them was not successful, as the ants built the mounds up through the boughs and extended them beyond their periphery.

The difficulties of controlling *Blissus hirtus*, Montd., in dense lawns that include bent grass [*Agrostis*] and are spongy in texture are briefly reviewed by Johnson (pp. 372–373). In experiments, good results were obtained in hot dry weather by applying tobacco dust containing 1 per cent. nicotine or derris dust containing ½ or 1 per cent. rotenone, used at the rate of 25 lb. per 1,000 sq. ft. of lawn [*cf.* **25** 688]. Mortality was particularly high when dusting was carried out on a clear day with a mean temperature of 92°F. and extremely low when heavy rains followed the treatment. Two applications are required to control a severe infestation in dense turf, even under favourable conditions. Tobacco dust containing ½ per cent. nicotine gave poor results.

A brief account of tests of chemicals to prevent the breeding of *Scolytus multistriatus*, Marsh., in elm logs is given by P. Wallace (pp. 374–375). The logs were stacked in mid-July on sleepers that harboured both *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., and *S. multistriatus*, in a forest near severely infested fallen trees and cut wood. Examination in October showed that complete protection from attack by any bark- or wood-boring insect was afforded by brushing the entire surface of the logs with coal-tar creosote. Logs that were creosoted on the upper half only were protected fairly well, but untreated logs placed among them were attacked. A significant reduction in brood galleries was given by spraying with two proprietary tar distillates, but on the whole the results were not satisfactory, and spraying with 3 per cent. borax by weight in water was completely ineffective.

Brief notes by several authors on miscellaneous pests (pp. 375–380) include records by Friend of infestation of two stands of hemlock [*Tsuga*] by the Geometrid, *Ellopia athasaria*, Wlk., and of a plantation of red pine [*Pinus resinosa*] by the European sawfly, *Gilpinia frutetorum*, F. The latter was identified from the United States for the first time in 1938 [*cf.* **27** 600], and a few larvae were observed in the Connecticut plantation in September of that year and a few cocoons in June 1939. In August 1940, 500 larvae were collected in less than an hour, which indicates that the infestation was increasing. Larvae of *E. athasaria* were abundant on trees 6–18 ins. in diameter and completely defoliated some of the smaller trees and the upper parts of the larger ones. They pupate in September, and the pupae hibernate in the litter under the trees; as many as 35–50 per sq. yd . occurred in a sample taken close to the bases of the trunks in the winter of 1940–41.

TURNER (N.). **Control of the European Corn Borer by Sprays and Dusts.**—*Circ. Conn. agric. Exp. Sta.* no. 147 pp. 35–43, 3 figs., 1 ref. New Haven, Conn., 1941.

A brief review is given of the seasonal history of *Pyrausta nubilalis*, Hb., on sweet maize in Connecticut, together with recommendations for control based on recent experiments [*cf. R.A.E.*, A **30** 129, 550].

LANGE jr. (W. H.). **The Artichoke Plume Moth and other Pests injurious to the Globe Artichoke.**—*Bull. Calif. agric. Exp. Sta.* no. 653, 71 pp., 29 figs., 47 refs. Berkeley, Calif., 1941.

The author describes all stages of the Pterophorid, *Platyptilia carduidactyla*, Ril., which causes severe damage to globe artichokes (*Cynara scolymus*) in California, gives a list of its other food-plants, which comprise cardoons (*C. cardunculus*) and thistles, particularly species of *Cirsium*, and discusses its history, distribution, systematic position and economic importance. Investigations in 1936–40 showed that there are three overlapping generations in the year in the coastal areas, all stages being present every month. The eggs are laid chiefly at night, on the undersides of the leaves, or occasionally on flower heads, leaf veins, leaf stalks or stems. The larvae migrate to the base of the plants; the first two instars are generally spent among the tender leaves and the last two inside the leaf stalks or preferably the buds. Pupation occurs on any part of the plant, but generally in the larval burrows in the leaf stalks or on the outer bracts of the floral heads. The adults fly chiefly at night, but are relatively inactive at temperatures below 50°F.; they usually mate within three days of emerging, and the females deposit 70–300 eggs after a preoviposition period of 3–8 days. The rate of development varied with the time of year, the egg, larval and pupal stages lasting 8–24, 32–86 and 10–30 days in the field, the total length of the immature stages 80–110 days and the adult life about a month. Summer-generation eggs are laid in March–July, and large numbers perish when the tops of the plants are cut off between mid-April and mid-June, but oviposition on the new shoots begins when they are only a few inches high. This generation does little damage, since few floral heads are present. The first adults emerge at about the end of August. The larvae of the autumn generation hatch when many heads are being produced and cause severe damage. A few adults of this generation emerge and oviposit in November and December and the remainder in the following spring. Increased injury in January and February is caused by surviving larvae of the autumn generation and those of the winter-spring generation, the first adults of which appear in March. There is no evidence of prolonged hibernation or aestivation.

The most effective parasite was *Angitia platyptiliae*, Cushm. [*cf.* **28** 320], which attacked 2–90 per cent. of the larvae during 1937–39 and also parasitises *Phlyctaenia rubigalis*, Gn.; it was itself parasitised by *Dibrachys cavus*, Wlk., and *Gelis* sp. *Pimpla* (*Epiurus*) *bicoloripes*, Ashm., is effective only on larvae feeding on thistles, particularly during May–August, and *Phaeogenes* sp. parasitises larvae on thistles in California and Oregon and occasionally attacks those on artichoke; *Pachyneuron allograptae*, Ashm., has been bred from it. Single examples of the Ichneumonid, *Colpognathus helvus*, Cress., and the Braconid, *Microbracon nevadensis*, Ashm., and a few of the Tachinids, *Clistomorpha* (*Hyalomyodes*) *triangulifera*, Lw., *Lispidea* spp. and *Plectops* sp. have also been bred from the larvae of *Platyptilia carduidactyla*. No egg parasites were found in the field, and though one species or race of *Trichogramma* readily attacked eggs in the laboratory, conditions appear to be unfavourable for the establishment of *Trichogramma* spp. Staphylinid larvae and undetermined species of spiders destroy the larvae, and the cliff swallow, *Petrochelidon lunifrons*, the adults; the mite, *Anystis agilis*, Banks, feeds on the eggs [*cf.* **28** 609].

In extensive experiments in 1937–38, insecticides did not give adequate control, owing to the presence of all stages throughout the year and of at least two generations during the growing season, the boring habits of the larvae and the structure of the plants, which made it difficult to penetrate the axils of the shoots. Sprays were generally more effective than dusts, cubé powder, nicotine sulphate and fixed nicotines giving limited control. The use of attractants or repellents was not promising, and light-traps, at the rate of one dark-blue light per acre, did not give adequate protection when used as a sole

means of control; of the different colours tested, dark blue was found to attract most adults and the highest percentage of females. A combination of cultural methods and field sanitation throughout the year was found to offer the most adequate and economical control. The most satisfactory means of disposing of the tops of the plants was to place them in a ditch between the rows and cover them with at least a foot of soil within a few days; burning the plants has the disadvantage of not returning humus to the soil. The use of a rotary plough or disking the plants was not very effective in destroying the immature stages.

The only other Pterophorid observed feeding on artichoke was *Platyptilia williamsi*, Grinnell, which causes damage similar to that due to *P. carduidactyla*. It attacks many species of Compositae, a list of which is given, and is sometimes a serious pest of *Calendula*, but is not at present of economic importance on artichoke. Its life-history is similar to that of *P. carduidactyla*, but there are four generations in the year. Parasites of the larvae comprise *Campoplex* sp., *Pimpla bicoloripes* and *Angitia* sp., which is the most effective, though it is itself parasitised by *Hemiteles* sp. Other Pterophorids taken as adults on artichoke plants or at light included *Oidaematophorus monodactylus*, L., *O. grandis*, Fish, *O. phoebus*, Barnes & Lindsey, *P. albiciliata*, Wlsm., *P. antirrhina*, Lange, *P. fuscicornis*, Zell., and *P. crataea*, Fletcher. A key to the species of *Platyptilia* is given.

Capitophorus braggi, Gill., is the commonest Aphid on artichoke, which it may damage throughout the year. When infestation is severe, wilting of the plants delays their growth for several months. Its natural enemies include Coccinellids, Syrphid larvae and a fungus. Experiments in 1938 showed that good control was given by a dust containing 10 per cent. nicotine sulphate, applied at the rate of 35–50 lb. per acre when the Aphids were first abundant, a cubé dust containing 1 per cent. rotenone, particularly with the addition of a wetting agent, such as Vatsol-OS (1 per cent.), and sprays containing 1 U.S. pint nicotine sulphate or 4 lb. cubé powder (4 per cent. rotenone) with 1 U.S. gal. light-medium oil emulsion and 100 U.S. gals. water. *Aphis rumicis*, L., is often common on artichoke, but not usually injurious under field conditions; it is controlled by the same means as *C. braggi*. *Anuraphis padi*, L. (*Aphis helichrysi*, Kalt.), though abundant on the floral heads, is not sufficiently so to require control. *Phytomyza atricornis*, Mg., mines the leaves of artichoke and common weeds in its vicinity, and *Phlyctaenia rubigalis* often causes considerable injury to the floral heads in spring by feeding on the inside of the bracts and webbing them. Adults of this Pyralid lived about 40 days and deposited 250–400 eggs at outdoor temperatures during April and May 1938; the egg stage lasted 18–25 days in the field and development from hatching to adult emergence 66–72 days during February–April at a mean average temperature of 59·77°F. The adults of *Peritelopsis globiventris*, Lec., feed on the roots and crowns of artichoke during May-July [*cf.* **25** 249; **30** 262], and those of *Diabrotica undecimpunctata*, Mannh., often cause considerable damage to young plants and floral heads. Larvae of *Choreutis melanifera*, Keifer, and *Vanessa cardui*, L., feed on the leaves, those of *Heliothis armigera*, Hb., occasionally attack artichokes growing near maize fields, and those of *Estigmene acraea*, Dru., and *Sabulodes caberata*, Gn., often feed on the floral heads. Other moths, the larvae of which occasionally feed on artichokes, are *Tortrix* (*Argyrotaenia*) *citrana*, Fern., *T.* (*A.*) *franciscana*, Wlsm., *T.* (*Clepsis*) *busckana*, Keifer, *Emboloecia sauzalitae*, Grote [*cf.* **28** 85], *Plusia* (*Autographa*) *californica*, Speyer, *P.* (*A.*) *brassicae*, Ril., *Cirphis unipuncta*, Haw., *Euxoa messoria*, Harr., *Zosteropoda hirtipes*, Grote, *Peridroma saucia*, Hb. (*margaritosa*, Haw.) and *Pyrausta inequalis*, Gn. (*subsequalis*, Gn.). Other pests of minor importance are *Porcellio scaber*, Latr., which makes holes in the leaf-stalks, *Lygus sallei*, Stål, which appears to deform the leaves and retard the growth of small plants during the summer, and *Cheilosia baroni*, Will., and *Paracantha culta*, Wied., which occasionally bore in the crowns of artichoke shoots.

Lists of all the insects found associated with artichoke during the investigation and the parasites that attack them are appended, with notes on other pests and the diseases that affect the plant.

HUNT (H. A.) & CARTER (W. B.). **The known Occurrence of Tomato Pinworm (*Keiferia lycopersicella*) in California.**—*Bull. Dep. Agric. Calif.* **30** no. 2 pp. 167–169, 1 fig., 1 ref. Sacramento, Calif., 1941.

An account is given of the methods and results of a survey to determine the distribution of *Keiferia lycopersicella*, Busck, on tomato, carried out in those parts of California likely to contain infestations. It is concluded that the whole of southern California is infested [*cf. R.A.E.*, A **30** 307]. It became increasingly difficult to find *K. lycopersicella* as the survey progressed from south to north, and *Gnorimoschema operculella*, Zell., was found on tomato in the central Coastal Region [*cf. loc. cit.*].

MICHELBACHER (A. E.). **Control of the Corn Earworm on Sweet Corn.**—*Bull. Dep. Agric. Calif.* **30** no. 2 pp. 175–183, 5 figs., 5 refs. Sacramento, Calif., 1941.

The results are given of two experiments to determine the effectiveness in California of injecting oil into the "silk channel" of sweet maize for the control of *Heliothis armigera*, Hb., which attacks almost all ears late in the season. In the first, oils with viscosities of about 100, 175 and 105 seconds Saybolt and unsulphonatable residues of about 98, 94 and 99 per cent., respectively, to the first of which 1 per cent. oleoresins of pyrethrum was added to give a pyrethrin content of 0·2 per cent., were applied to a tight-husked variety at the rate of 1 cc. per ear when the silks had wilted. The oil containing pyrethrum was much more effective than the oils used alone [*cf. R.A.E.*, A **28** 184], 75 per cent. of the ears being free from infestation at harvest time and 69 per cent. when the maize was collected for seed; nearly all untreated ears were infested and more severely damaged than the infested treated ears. The kernels usually failed to develop at the tip of the ear, and when the oil was applied long before fertilisation was complete, they did not develop for some distance from the tip. In the second experiment, treatment of a loose-husked variety, which was planted late, with two types of oil with viscosities of 100 and 185–195 and unsulphonatable residues of about 99 per cent., each containing 0·2 per cent. pyrethrins and applied at 0·85 or 1 cc. per ear, gave good control, with 79–84 per cent. uninfested ears. Failure of the kernels to develop at the tips of treated ears was not serious, and injury to the lower kernels was attributed to heavy infestation by *Diabrotica undecimpunctata*, Mannh. (*soror*, Lec.) or large migrating larvae of *Heliothis*, which destroyed the silks, rather than to the oil. The heavier oil appeared to cause less tip injury than the lighter one.

The author recommends that this treatment, which is rather expensive, should be applied only when necessary and not until the fertilisation of the ear is complete. Between 0·85 and 1 cc. of an oil with a viscosity of 180–200 and an unsulphonatable residue of about 99 per cent., containing 0·2 per cent. pyrethrins, should be injected into the "silk channel" after the external silk has begun to wilt and turn brown.

KEIFER (H. H.). **Eriophyid Studies XI.**—*Bull. Dep. Agric. Calif.* **30** no. 2 pp. 196–215, 9 pls., 2 figs., 1 ref. Sacramento, Calif., 1941.

This part of a series [*cf. R.A.E.*, A **29** 565] comprises descriptions of a new species of *Anthocoptes* and four new species of *Eriophyes*, redescriptions of *E. essigi*, Hassan, and of *Phyllocoptes eurynotus*, Nal., which browns the stalks of celery in California, and notes on *E. vaccinii*, Keifer, and *P. cornutus*, Banks. The author describes the life-history of *E. vaccinii* and the injury it causes to

blueberry [*cf.* **29** 259], and gives a list of its wild and cultivated food-plants (*Vaccinium* spp. and *Gaylussacia baccata*), showing the locality and type of damage, and another of species of Vacciniaceae on which it was not observed. It has been found on the Atlantic coast from Massachusetts to Georgia.

Peach leaves showing damage by *P. cornutus* [**27** 33] were collected in California in late September and early October 1940. They bore few living mites but numbers of dead males, whereas twigs from the same tree were infested either within the outer bud scales or between the bud and the stem by numerous clusters of living mites, all of which were females, structurally of one species and noticeably different from the dead mites on the leaves. The author concludes that they represent a winter form of *P. cornutus*, which therefore exhibits an alternation of generations, with the summer leaf form of both sexes and winter hibernating form of females only. The new form is described.

STAHLER (N.). **Psyllid Galls on Avocado.**—*Bull. Dep. Agric. Calif.* **30** no. 2 p. 217, 1 fig. Sacramento, Calif., 1941.

The author records that large numbers of Psyllid galls, believed by H. H. Keifer to be those of *Trioza koebelei*, Kirk., were found on avocado leaves in an orchard in Mexico, 165 miles south of Monterrey, in January 1941, and points out that this is much nearer to the United States border than previous records.

List of Intercepted Plant Pests, 1940.—*S.R.A., B.E.P.Q.* [1940] 71 pp. Washington, D.C., U.S. Dep. Agric., 1941.

In this list of pests intercepted between 1st July 1939 and 30th June 1940 with plants or plant products entering United States territory (including Hawaii and Porto Rico), the selection of data is the same as that in previous ones [*cf. R.A.E.*, A **29** 348, etc.], but the arrangement of the main part of the report is altered, so that the information is tabulated under the names of the pests and indexed under the plants and under the countries of origin, instead of being given under the countries of origin without indexing.

Studies on the Biology of four common Carpet Beetles. GRISWOLD (G. H.). **Part I. The Black Carpet Beetle** (*Attagenus piceus* **Oliv.), the Varied Carpet Beetle** (*Anthrenus verbasci* **L.), and the Furniture Carpet Beetle** (*Anthrenus vorax* **Waterh.).** GREENWALD (M.). **Part II. The Old-fashioned Carpet Beetle** (*Anthrenus scrophulariae* **L.).**—*Mem. Cornell agric. Exp. Sta.* no. 240, 75 pp., 41 figs. 5½ pp. refs. Ithaca, N.Y., 1941.

In these papers, which record the results of studies carried out at Ithaca, New York, over a period of several years, the information on each species is arranged in the same way, brief sections on its classification, synonymy and distribution being followed by descriptions of all stages and biological data. The following is based on the authors' summaries.

Attagenus piceus, Ol., *Anthrenus verbasci*, L., and *A. vorax*, Waterh., are widely distributed in the United States and throughout the world, and cause serious injury in the larval stage to materials of animal origin, such as woollens, hair, fur, feathers and dead insects. *Attagenus piceus* and *Anthrenus verbasci* also feed on cereal products, and are sometimes troublesome in flour mills. Temperature has a marked effect on the duration of the egg stage of all three species ; it is twice as long at 65°F. as at 75°. At the latter temperature, the eggs of *Attagenus piceus*, *Anthrenus verbasci* and *A. vorax* hatched in about 10, 15 and 17 days, respectively ; humidity had little if any effect on the duration of the egg stage of the first two. The larval period lasted from 8 to 21 months for *Attagenus*, never less than 7 months for *Anthrenus verbasci* and from 4 months to over a year for *A. vorax*. The duration of the pupal stage was

considerably affected by temperature, but not by humidity. It was about 9 days for *Attagenus piceus* and 10 for *Anthrenus verbasci* at 75°F., and 12 for *A. vorax* at 77–80°.

Adults of *Attagenus piceus* lived longer at 65°F. than at 75° and longer at 75 than at 85°. Temperature also affects the durations of the pre-oviposition, oviposition and post-oviposition periods, and, to some extent, the number of eggs laid. Adults of this species and *Anthrenus verbasci* lived for about 2–7 weeks at room temperature, but those of *A. vorax* lived much longer, unmated males and females surviving for 44–230 and 56–251 days, respectively. In the case of *Attagenus* there appeared to be a definite inverse correlation between the length of the development period and the length of adult life. The terminal antennal segment in males of *A. piceus* is twice as long as in females, but the sexes of the species of *Anthrenus* cannot be distinguished by external characters.

The world distribution of *Anthrenus scrophulariae*, L., is wide but irregular. The eggs hatch in about two weeks at room temperatures. The larvae cannot develop unless they feed on animal products in some form ; they may attain full growth in 52–80 days or require a much longer period. At about 80°F., the pupal stage lasted 9–10 days. The entire development period may vary from 78 to 439 days. Adults reared in the incubator spent 56–84 days in the old larval skins in which pupation had taken place. After crawling out, they lived for 4–8 days. The beetles feed on pollen ; a review of the literature showed that they have been recorded on plants of 27 species and 13 families, a list of which is given.

WATERSTON (J. M.). **Controlling Diseases and Pests of Fruit Trees.**—*Agric. Bull. Bermuda* **19** no. 5 pp. 35–38. [Hamilton] 1940. [Recd. 1942.]

Notes are given on the control of insect pests and diseases that attack fruit trees in Bermuda. Pigeon peas [*Cajanus cajan*] sown in May are recommended as temporary wind-breaks in newly-planted orchards. In addition to providing shelter, windbreaks encourage the spread of entomogenous fungi that attack Coccids, which if unchecked may render fruit-growing unprofitable, especially in the case of *Citrus*. Ants that tend Coccids and Aphids can be kept off the trees by banding with a mixture of equal parts of resin and castor-oil, preferably with the addition of 1 part in 6 of finely powdered sulphur, or destroyed in their nests by methods already noticed [*R.A.E.*, A **21** 356].

Cosmopolites sordidus, Germ., is the only important pest of banana ; it can be checked by clean cultivation and by trapping the adults under split banana stems laid cut side down on the ground. European grape-vines should be grafted on to American stocks as a measure against *Phylloxera vitifoliae*, Fitch (*vastatrix*, Planch.) and infested vines should be destroyed. *Lepidosaphes beckii*, Newm., and *Dialeurodes citrifolii*, Morg., are the most important pests of *Citrus*, and can be controlled by an application of a 1 per cent. oil emulsion in April–May and another in September–October ; additional applications can be made, if necessary, except from the time of the appearance of the flowers until the fruits are 1 inch in diameter. Other Coccids against which oil emulsion is effective are *Pseudococcus nipae*, Mask., *Pulvinaria* (*Protopulvinaria*) *pyriformis*, Ckll., and *Chrysomphalus dictyospermi*, Morg., on avocado ; *Morganella longispina*, Morg., on fig ; *Pseudoccocus nipae* and *Saissetia nigra*, Nietn., on sugar-apple [*Annona squamosa*] ; and *Aulacaspis pentagona*, Targ., against which wettable sulphur is also effective, on peach. *Spilonota smithiana*, Wlsm., bores the shoots of guava in early spring and can be controlled by sprays or dusts of lead arsenate. Recommended measures against *Ceratitis capitata*, Wied., on guava, loquat [*Eriobotrya japonica*], fig and peach comprise the use of glass bait-traps containing Clensel and water (1 : 20) and bait-sprays containing 5 lb. sugar and 6 oz. lead arsenate or 2 oz. sodium fluosilicate in 8 gals. water applied weekly until the fruit is half formed, the removal and destruction of fallen fruit and

general orchard sanitation. Peach trees can be screened at the time of fruiting, but successful control depends largely on the degree of control on peppers [*Capsicum*], surinam cherry [*Eugenia uniflora*] and other fruit trees in the neighbourhood.

WATERSTON (J. M.). **A new Pest of *Citrus* in Bermuda.**—*Agric. Bull. Bermuda* **19** no. 7 pp. 52–53. [Hamilton] 1940. [Recd. 1942.]

The Lamiid, *Leptostylus praemorsus*, F., was recently reported to be damaging *Citrus* for the first time in Bermuda [*R.A.E.*, A **30** 167], where it normally infests *Juniperus bermudiana* and, to a less extent, *Poinciana* (*Delonix*) *regia*, *Bauhinia monandra*, *Lagerstroemia indica* and *Eugenia uniflora*. The eggs are laid only in dead or dying parts of the trees, the death of which is often hastened as a result of larval feeding. The larvae may attack the stem near to the ground or decayed stubs left during pruning, and tunnel in the soft wood below the bark. The species of *Citrus* in which they were found were lemon and sweet orange. The branches of these trees were in some cases completely girdled before any visible symptoms appeared ; they had apparently healthy foliage and were laden with fruit. Dead and shrunken patches of bark, darker in colour than the rest, with fine sawdust in the cracks, are an indication of infestation. The only effective control measure is to remove the larvae with a knife in late summer, prune back to healthy green tissue, thoroughly clean the wound and treat the exposed wood with pruning paint. Infested trees of *J. bermudiana* in the neighbourhood should also be treated, and all prunings should be destroyed. If infestation is expected to be severe, the trunk and branches should be painted with a repellent made by dissolving 25 lb. fish-oil soap in 1½ gals. hot water, adding 2 lb. flour and 12½ lb. flaked naphthalene, and heating the mixture to 180°F. until the naphthalene is dissolved. The mixture should be thinned to the consistency of paint for application.

Agriculture and Animal Husbandry in India 1938–39.—422 pp., 10 pls. Delhi, 1941.

Much of the information on insect pests (pp. 151–161) in this review of work in India, chiefly during 1938–39, has already been noticed. Increased yields of cotton followed the destruction of cotton stubble and alternative food-plants of *Earias fabia*, Stoll, after harvest in the Punjab [*cf. R.A.E.*, A **28** 464] and the use of seed that had been exposed to the sun to destroy long-cycle larvae of the pink bollworm [*Platyedra gossypiella*, Saund.] in the United Provinces. *Empoasca devastans*, Dist., and (?) *E. formosana*, Paoli, were found to be common in Sind, the former on cotton, bhindi [*Hibiscus esculentus*], brinjal [*Solanum melongena*] and potato and the latter on *Cyamopsis psoraloides*, *Dolichos lablab*, *Vigna unguiculata* (*catjang*) and *Trifolium alexandrinum*. *Pempherulus* (*Pempheres*) *affinis*, Faust, was observed for the first time in Mysore, where local infestation of cotton by it was severe.

An outbreak of *Pachydiplosis oryzae*, Wood-Mason, was reported on rice in a district of the Central Provinces and was stated to have been controlled by means of light-traps. *Cnaphalocrocis medinalis*, Gn., was injurious for the first time in Cochin, where it was controlled by destroying the upper part of infested plants and applying a stimulating fertiliser. Damage by this species is estimated to cause the loss of 10 per cent. of the rice crop in South Travancore. *Hispa armigera*, Ol., is present throughout the year in Assam and Bengal, where there are several alternative food-plants ; in both Provinces, damage to deep-water rice was rather severe, and in Assam it continued from April until August. Pyrethrum dust and a spray containing pyrethrum extract were effective against this pest in Assam, despite rainy weather.

Dacus correctus, Bez., and *Carpomyia vesuviana*, Costa, severely injured fruits of *Zizyphus jujuba* in the Madras Presidency. The only effective measure

was the destruction of the pupae by raking the soil beneath the trees; baits containing amyl acetate, citrol, citronella oil, lemon grass oil or Clensel, and a bait-spray of poisoned molasses were of no value. In the course of surveys of pests of fruit trees in the Punjab and the North-west Frontier Province, the San José scale [*Aspidiotus perniciosus*, Comst.] was recorded on alder (*Alnus nepalensis*). Other new records included *Apriona cinerea*, Chevr., tunnelling in the stems of peach, and *Mimastra cyanura*, Hope, on mulberry, plum and apricot. It was found that upward and downward migration of the woolly aphis [*Eriosoma lanigerum*, Hsm.] on apple continues throughout the year in the United Provinces, the movements being slight during winter; three varieties of stock, including *Pyrus baccata*, proved to be highly resistant, and spraying with a mixture containing soft soap and nicotine sulphate in summer and resin soap and a little creosote oil or tobacco extract in winter was very effective, although a spray containing 1 oz. nicotine sulphate in 5 gals. water in the Madras Presidency was not. It was observed in studies during 1936–1939 on *Dorysthenes* (*Lophosternus*) *huegeli*, Redt., which attacks apple in the United Provinces, that 74 per cent. of the infested trees occurred on sandy soil, 14 per cent. on loamy soil, and 12 per cent. on clay; a soil moisture content of 20–40 per cent. proved most suitable for oviposition and for the hatching and survival of the young larvae. The newly-hatched larvae feed on all kinds of organic matter, but well rotted manure is toxic to them. The larval stage occupies four years. Of the three species of *Idiocerus* that occur [on mango] in Bombay, *I. niveosparsus*, Leth., is the most injurious towards the north and *I. clypealis*, Leth., towards the south; *I. atkinsoni*, Leth., is abundant only during the summer monsoon season, when the other two species are practically absent. Dusting with sulphur gave effective control of *I. clypealis*, but several applications were necessary against *I. niveosparsus* and *I. atkinsoni*; the sulphur was not rendered more effective by the addition of Cyanogas calcium cyanide (1 : 6). Pests of fruit in Bengal include *Deporaus* (*Eugnamptus*) *marginatus*, Pasc., which injured young leaves of mango and was controlled by spraying with lemon chrome [barium chromate], and *Virachola isocrates*, F., on pomegranate, the fruits of which were protected by enclosing them in muslin bags.

In experiments with sprays of tobacco extract against pea aphis [*Macrosiphum onobrychis*, Boy.] in Bombay, 5–7 applications at weekly intervals were necessary for control; treatment must be prompt. Rain interfered with attempts to control *Scirtothrips dorsalis*, Hood, on chillies [*Capsicum*] by means of sulphur and tobacco dusts applied 84 and 104 days after planting out, but late applications of sulphur were injurious and reduced the yield by 15·5 per cent. A heavy infestation in Travancore was controlled by a prompt application of a tobacco decoction. *Plutella maculipennis*, Curt., severely damaged young cauliflower plants in Bengal and was controlled by a spray containing 2 oz. barium chromate and 4 oz. Clensel in 4 gals. water. Dusts containing pyrethrum gave good results against *Gnorimoschema* (*Phthorimaea*) *heliopa*, Lower, on seedling tobacco in Mysore. The bionomics of *Stomopteryx nerteria*, Meyr., which is a serious pest of ground-nut [*Arachis hypogaea*] in South India, were studied at Coimbatore, where the life-cycle was found to occupy 21–24 days. The moths were attracted to light-traps. *Anisolabis annulipes*, Lucas, was observed attacking ground-nut for the first time at Coimbatore; the egg and nymphal stages occupied 7–11 and 35–60 days.

Taeniothrips cardamomi, Ram. Ayyar, damaged as many as 60 per cent. of the pods of cardamom [*Elettaria cardamomum*] on some estates in the Anamalais [*cf.* **23** 745]; it is believed to be a vector of cardamom mosaic. Sulphur and pyrethrum dusts gave encouraging results against it in Mysore, and it was effectively controlled in Travancore by a spray prepared by steeping 1 lb. tobacco waste in 15 gals. water. *Eupterote canaraica*, Moore, became injurious on cardamom in Mysore for the first time for 15 years. Destruction of the pupae is not difficult as they occur in masses of excreta and soil beneath

the trees, and the pupal stage occupies six months. Many larvae were killed by a fungus during the north-east monsoon rains. In Travancore, where this moth is often of importance, fish-oil soap, used at the rate of 1 lb. in 5 gals. water, was the most effective insecticide tested.

In Mysore, *Xyleborus morstatti*, Hag., was found to breed in *Crotalaria* sp. and *Clerodendron* sp. during the four or five summer months in which it does not breed in coffee twigs. *Orthacris incongruens*, Carl, was injurious to tea on an estate in the Nilgiris, where the poison bait containing bran, Paris green and molasses in general use was ineffective. In experiments in Madras, stored grain was more effectively protected against infestation by *Calandra oryzae*, L., and *Rhizopertha dominica*, F., by drying it monthly in the sun than by mixing various materials with it. Of the latter, powdered acorns and a mixture of lime and creosote gave better results than several others, including pyrethrum and derris.

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